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Vol. 46. Ser. A. Part 10. pp. 361–404. OCTOBER, 1958.

THE REVIEW OF APPLIED ENTOMOLOGY

SERIES A: AGRICULTURAL

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
56, QUEEN'S GATE, S.W.7.

Price 6s. net.

Commonwealth Agricultural Bureaux

COMMONWEALTH INSTITUTE OF ENTOMOLOGY

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Markkula (M.) & Myllymäki (S.). **Investigation into the Oviposition on Red and Alsike Clover and Alfalfa of** *Apion apricans* **Herbst,** *A. assimile* **Kirby,** *A. flavipes* **Payk.,** *A. seniculus* **Kirby and** *A. virens* **Herbst. (Col., Curculionidae).**—*Ann. ent. fenn.* **23** (1957) no. 4 pp. 203–207, 2 figs., 4 refs. Helsinki, 1958.

Recent research in Finland has shown that *Apion apricans* Hbst., *A. assimile* Kby. and *A. virens* Hbst. are important pests of red clover [*Trifolium pratense*], and *A. dichroum* Bedel (*flavipes* (Payk.)) and *A. seniculum* Kby. of alsike clover [*T. hybridum*]; *A. dichroum* also attacks white clover [*T. repens*]. The larvae are the most injurious, but the adults cause considerable damage when numerous. Adults of all these weevils have been taken on various clovers and even lucerne, and laboratory experiments were therefore carried out to ascertain whether they would oviposit on them. The results showed very definite preferences. Females of *A. apricans*, *A. assimile* and *A. virens* laid 25–130, 45–179 and 7–54 eggs each on red clover, but only one-tenth as many on alsike clover. *A. dichroum* laid 29–66 on alsike clover, but none on red clover or lucerne, and *A. seniculum* 26–67 on alsike clover; the only female of the latter placed on red clover died in five days without ovipositing. *A. seniculum* and *A. virens*, which lay their eggs in the stems, began oviposition at the end of May and completed it 2½ months later. The other species, which oviposit on the inflorescences, began a fortnight later and completed oviposition in a little more than two months. On alsike clover, the oviposition period of *A. apricans*, *A. assimile* and *A. virens* lasted less than a month.

Crooke (M.). **Experiments on the Control of the Pine Weevil,** *Hylobius abietis* **L.**—*7th Brit. Commonw. For. Conf. 1957* repr. 37 pp., 9 refs. London, For. Comm., 1957.

The following is substantially the author's summary of this detailed account of experiments in Britain in 1954–56. The results are given of experiments on the protection of Scots pine [*Pinus sylvestris*] in newly formed plantations from attack by the pine weevil (*Hylobius abietis* (L.)), using the insecticides DDT, BHC and dieldrin at various rates, applied either as dips before planting or as sprays or dusts after planting. Almost all the different treatments gave adequate levels of practical protection, and the choice of a standard method depends almost entirely on convenience and on cost. In general, dipping is to be preferred, and the most suitable material is considered to be 5 per cent. DDT. Spraying and dusting are useful where weevil attack develops unexpectedly, but they are more expensive than dipping. Spraying is probably more convenient than dusting, although the latter gives slightly better results, and a spray of 1 per cent. DDT at the rate of 50 cc. per plant is recommended. Retreatment in the second season improves the protection afforded, but not sufficiently to render double treatment economic.

Labeyrie (V.). **Sur les conditions de pullulation en France de la bruche du haricot (***Acanthoscelides obsoletus* **Say) en culture.**—*C.R. Acad. Agric. Fr.* **43** no. 11 pp. 590–593, 1 map, 8 refs. Paris, 1957.

Infestation of beans by *Acanthoscelides obsoletus* (Say) in France was observed for the first time in 1873 in the extreme south. It has since spread widely, but not to Brittany or the Channel area. The limiting factor is the minimum temperature required for migration of the adults from storehouses to beans in the field, which has been shown in unpublished work to be

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18–20°C. [64·4–68°F.], and the replies to a questionnaire on the occurrence of the Bruchid in 1952 and 1953 indicated that its distribution was limited by the average July isotherm for 19°C. [66·2°F.]. This runs approximately along a line from Nantes to Charleroi, but varies somewhat with year. The distribution of the Bruchid and the position of the isotherm in 1950 and 1951 (an abnormally cool year) are shown on a map.

Pussard (R.). **Directives de lutte pour freiner les dégâts de la cécidomyie des lavandes.**—*C. R. Acad. Agric. Fr.* **43** no. 11 pp. 614–615, 3 refs. Paris, 1957.

The author discusses possible ways of controlling *Thomasiniana lavandulae* Barnes on lavender [*Lavandula vera*] in southern France [*cf. R.A.E.*, A **46** 206] and recommends the removal and destruction by burning of all hybrid lavender and the severe cutting back or destruction of heavily infested or abandoned lavender before the beginning of adult flight, the growing of leguminous forage crops for at least two years before cleared sites are replanted, the establishment of plantings in areas remote from infested ones, the use of uninfested planting stock, and the protection of the plants each year by two applications, at an interval of 4–5 days during the first important period of flight, of dusts of 10 per cent. DDT and 0·8 per cent. parathion, which should be alternated and which proved effective against the adult Cecidomyiids in field tests in 1954. Dusts are preferred to sprays, which might affect the quality of the perfume.

Frediani (D.). **Su alcuni imenotteri parassiti del *Pissodes notatus* F. nella Toscana litoranea.** [Some Hymenoptera parasitic on *P. notatus* on the Tuscan Coast.]—*Boll. Soc. ent. ital.* **87** no. 5–6 pp. 92–97, 3 figs., 8 refs. Genoa, 1957.

Pine trees growing in a small area on the coast of Tuscany were heavily infested by *Pissodes notatus* (F.) in June 1956. Parasites reared from material taken to the laboratory comprised *Calosota vernalis* Curt., *Eupelmus urozonus* Dalm., *Bracon* (*Habrobracon*) *palpebrator* Ratz. and *Spathius rubidus* Rossi. The respective parasitism percentages were 4, 0·6, 3·8 and 0·8.

Wallenberg (E.) & Järnhäll (B.). **Inverkan av vakuum på insekter.** [The Effect of Vacuum on Insects.]—*Opusc. ent.* **22** pt. 1 pp. 57–58. Lund, 1957. (With a Summary in English.)

The presence of insects in packets of cereal foodstuffs is undesirable, especially in the case of infant foods, which provide a very favourable medium for the development of pests. Many such commodities are now packed under vacuum in flexible plastic containers. A preliminary test on stored-product insects of ten species showed that reducing the pressure to 100 mm. mercury had little effect on them unless the vacuum was maintained for several hours and the containers left unopened for several days. In a more detailed experiment, examples of *Tribolium castaneum* (Hbst.) were mixed into a commercial powdered food and this was packed in bags of plastic film so that each bag contained about 25 larvae, 25 adults or five pupae. The pressure in the bags was reduced to 100 mm., and the bags were then kept in a special apparatus. The reduction in pressure in the bags led to considerable compression of the product, which would presumably prevent movement of the insects, and, in case this might affect the results, a further set of samples was treated in tubes in similar bags, to

avoid compression. The medium was conditioned to a moisture content of 18·5 per cent. to obviate any effects of dryness, and all samples were kept in the dark at about 25°C. [77°F.] after treatment. Periodical observations showed that 22, 4 and 0 of 25 larvae and 21, 20 and 0 of 25 adults subjected to compression were alive after 1, 2 and 3 days, respectively; all those not so subjected died in two days, and none of the pupae gave rise to an adult. It is concluded that vacuum treatment is promising for the control of insects in foods packed in this way.

Masaki (S.). **The Effect of Temperature on the Termination of pupal Diapause in** *Barathra brassicae* **Linné (Lepidoptera: Noctuidae).**—*Jap. J. appl. Zool.* **21** no. 3 pp. 97–107, 10 figs., 15 refs. Tokyo, 1956.

The following is based on the author's summary of this account of laboratory experiments in Japan. Pupae of *Mamestra* (*Barathra*) *brassicae* (L.) require exposure to temperatures ranging from 0 to 12°C. [32 to 53·6°F.] for the rapid completion of diapause. The optimum temperature is about 5°C. [41°F.], and the lower and upper limits are below 0°C. and about 20°C. [68°F.], respectively. At the optimum temperature, the diapause lasts 20–95 days, with a mean of 37 days. Post-diapause morphogenesis is most rapid at 30°C. [86°F.], and its lower limit is about 8°C. [46·4°F.]. Thermal requirements during the diapause stage are thus variable, and alternate low and high temperatures may be required. Intermittent exposure to high temperature reduced the effects of cold on completion of the diapause, but exposure to high temperature (26°C. [78·8°F.]) before cold exposure had no effect on the diapause, at least when it lasted less than 90 days.

Asket Singh. **Some critical Observations on the Feeding Activity of the Desert Locust,** *Schistocerca gregaria* **(Forskal), under different environmental Conditions.**—*Res. Bull. Panjab Univ. Zool.* no. 108 pp. 291–298, 1 fig., 24 refs. Hoshiarpur, 1957.

The amount of food consumed by adults and hoppers of *Schistocerca gregaria* (Forsk.) kept under crowded conditions and exposed to different conditions of temperature and light was determined in northern India during 1954–55. In an experiment on temperature, batches of 20 fifth-instar hoppers in small cages were kept for 18 days in an unheated laboratory, where the average maximum and minimum temperatures and relative humidity were 62·4 and 58·7°F. and 74·6 per cent., respectively, or were transferred from it daily from 10 a.m. to 6 p.m. to a sunny verandah where the average maximum and minimum temperatures and relative humidity were 68·2 and 58·7°F. and 69·3 per cent. Weighed fresh cabbage leaves were provided twice daily as food, and the uneaten portions subsequently weighed. Over the whole period, the hoppers exposed to the sun on the verandah consumed almost five times as much as the others by day and almost three times as much by night, and in consequence began their final moult after 18 days, whereas the others required 46 days to reach the same stage. When daily food consumption was correlated with weather conditions, there was a considerable reduction in the weight eaten, both in the laboratory and on the verandah, on cloudy and rainy days [*cf. R.A.E.*, A **25** 62]. In an experiment on the effect of light, in which two batches of about 20 adults were kept at 78–80°F. and 47·4 per cent. relative humidity, the weights of cabbage leaf consumed hourly averaged nearly 0·9 g. by day and about 0·5 g. by night. The average daily weight of food consumed

during the first ten days of adult life was almost three times the weight consumed during the following ten days or the preceding ten days, in which the final moult occurred.

Lodos (N.). **Türkiyede *Eurygaster integriceps* Puton (Süne) nin coğrafi yayılışına ait bazı düşünceler.** [Reflections on the geographical Distribution of *E. integriceps* in Turkey.]—*Tomurcuk* **6** no. 69 pp. 10–12, 2 maps, 10 refs. Istanbul, 1957. (With a Summary in English.)

Works on the distribution of *Eurygaster integriceps* Put. usually distinguish between areas where the bug is injurious and areas where it is not. The author gives a map of Turkey showing the region in which damage to cereals occurs every year, those in which it occurs occasionally, and those in which the bug is present, but not injurious, and another showing the principal mountain areas in which it overwinters.

Whellan (J. A.). **Some recent Observations on Maize Pests.**—*Proc. 2nd Conf. prof. Offrs Dep. Res. spec. Serv. 1956* pp. 45–47, 4 refs. [? Salisbury, S. Rhod., 1956.]

Busseola fusca (Fuller) is the principal stalk-borer of maize in Southern Rhodesia but the plant is also attacked by *Sesamia calamistis* Hmps. *B. fusca* has recently been reared from Napier grass (*Pennisetum purpureum*) grown for fodder, but the main species infesting this is a darker one [*B. phaia* Bowden (*R.A.E.*, A **44** 465)]. The larvae of the two species of *Busseola* are very similar in appearance, but differ physiologically in that the long winter diapause of *B. phaia* is easily terminated by raising the temperature and keeping the humidity high, whereas that of *B. fusca* cannot be terminated in this way. The complete life-cycles of *S. calamistis* and *B. phaia* are unknown, but that of *B. fusca*, apart from the duration of larval and pupal stages, is fairly well understood. There are two generations a year. The first few adults emerge as early as September, when only irrigated maize is available for oviposition, but emergence is not general until November. Eggs are laid under the leaf sheaths and hatch in about a week. The larvae feed at first on the young folded leaves and then bore into the stalk, in which they pupate, giving rise to adults in February–March. Larvae of the second generation damage the tassels of the cobs and then enter the stems, in which the dry season is passed, pupation not occurring until near the end of it. Control can be effected by cultural measures, including the destruction of maize stalks at the end of the season, late planting, and the use of trap crops, supplemented by insecticide treatment if necessary; a 2·5 per cent. DDT dust applied to the funnels when the plants are 1–2 ft. high is effective [*cf.* **46** 40, etc.], but 2–3 applications may be required since oviposition is effected over a period.

Maize is also damaged periodically by *Laphygma exempta* (Wlk.). An outbreak of this armyworm occurred in 1954 [*cf.* **45** 81], and a smaller one began in November 1955, earlier than heretofore. The main attack on maize began in early December, and a series of overlapping generations developed, so that larvae in all instars were present in some plantings until early February. Mercury-vapour light-traps of the Rothamsted type [*cf.* **43** 169] proved useful in forecasting larval abundance, though it appeared that only comparatively large catches were followed by an outbreak, and endrin sprays gave effective control [*cf.* **45** 371]. An unusual instance of oviposition on bare land in which the maize had not yet germinated is recorded.

Descamps (M.). **Insectes nuisibles au riz dans le Nord Cameroun.**—*Agron. trop.* **11** no. 6 pp. 732–755, 6 figs., 53 refs. Nogent-sur-Marne, 1956.

Rice has been grown in the north of the French Cameroons, particularly in the Logone valley, since 1952. It is attacked by numerous insects, and this paper consists of a list of them, classified according to the type of damage caused, with notes on their morphology and bionomics and on their parasites [*cf. R.A.E.*, A **46** 30]. The stem borers observed comprise *Adelpherupa* sp., which has two generations a year and is parasitised by *Eurytoma lepidopterae* Risbec, *Goniozus procerae* Risbec, two unidentified species of *Bruchobius* and two Ichneumonids; *Saluria* sp., which has 3–4 generations a year and is parasitised by *E. lepidopterae*, *G. procerae* and *Geron* sp.; *Scirpophaga* sp., which is parasitised by *Goniozus procerae* and four egg-parasites, *Telenomus ullyetti* Nixon, *T. tolli* Risbec, *Trichogramma* (*Xanthoatomus*) *ethiopicum* (Risbec) and an unidentified Trichogrammatid of a genus close to *Bloodiella*; a Pyralid referred to as *Proceras africana* Auriv.* [*cf.* **46** 29, 30], which is parasitised by *T. ethiopicum*, *G. procerae*, *Apanteles ruficrus* (Hal.), *Bracon* sp., *Charops* sp., *Coleocentrus* sp., *Tetrastichus sesamiae* Risbec and *Hyperchalcidia soudanensis* Steffan, and of which *Ceraphron braconiphagus* (Ghesq.) is a hyperparasite, having been reared from cocoons of *Charops* and *A. ruficrus*; *Sesamia* sp., which is parasitised by *Platytelenomus hylas* Nixon, *Pediobius* (*Pleurotropis*) *furvus* (Gah.), *A. sesamiae* Cam. and *Bracon quadrinotatus* Granger; *Pachydiplosis oryzae* (Wood-Mason) and *Pachylophus* sp. [*cf.* **46** 110]; and various Diopsids [*cf.* **46** 29]. Insects defoliating the plants include *Nymphula depunctalis* (Gn.) (*stagnalis* Zell.), which is important on young rice; *Marasmia trapezalis* (Gn.), which is parasitised by *Eurytoma syleptae* Ferrière, *Meteorus testaceus* Szépl., *Microgaster austrina* Wlkn. and *Brachymeria olethrius* (Wtstn.); *Epipagis cancellalis* (Zell.); *Brachmia* sp., which was unusually injurious in 1952 and is parasitised by *Nioro elegantula* Risbec and *Brachymeria albisquama* Krchb.; *Gegenes niso* (L.), which is parasitised by *Trichogramma ethiopicum*, *N. elegantula*, *B. globata* Steffan and *Thecocarcelia pelmatoprocta* Br. & Berg.; *Pelopidas mathias* (F.), which is parasitised by *Eurytoma syleptae*, *B. globata*, *Pseudoperichaeta* sp. and *T. pelmatoprocta*; *Diacrisia scotilla* Wllgr., which is parasitised by *Trichogramma ethiopicum*, *Tetrastichus sesamiae*, *Apanteles aethiopicus* Wlkn., *A. procerae* Risbec and other Braconids of the same genus, the species of *Apanteles* themselves having parasites; *D. maculosa* (Cram.) and *D. punctulata* (Wllgr.), which are less common than *D. scotilla*; *Creatonotus punctivitta* (Wlk.); *Spodoptera triturata* (Wlk.); *Laphygma exigua* (Hb.), which is parasitised by *Disophrys lutea* (Brullé), *Euplectrus laphygmae* Ferrière and *Apanteles aethiopicus*; *Psalis pennatula* (F.); *Laelia fracta* Schaus, which is parasitised by *Apanteles* sp. and unidentified Tachinids; *Heteronychus* sp.; *Epilachna similis* (Thnb.), which is parasitised by *Tetrastichus cydoniae* Risbec, *Pediobius* (*Pleurotropis*) *mediopunctatus* (Wtstn.), and *Paralitomastix polyphaga* Risbec (egg-parasite); *Lema* sp., parasitised by *Trichogramma ethiopicum* and unidentified Ichneumonids; and numerous grasshoppers. The leaf-miners comprise *Agromyza* sp., *Trichispa sericea* (Guér.), *Dicladispa paucispina* (Weise), *Polyconia spinicornis* (Kraatz) and *Dorcathispa bellicosa* (Guér.). Sucking insects include *Tettigella spectra* (Dist.) (*Tettigoniella albida* (Sign.)), which is parasitised by *Gonatocerus africanus* Risbec (egg-parasite) and

* The insect referred to under this name in French West Africa was originally identified by comparison with the specimens in the British Museum considered by Hampson to be *Diatraea africana* Auriv. [*cf. R.A.E.*, A **46** 172], but in view of Martin's findings [*loc. cit.*] its identity is uncertain.—*Ed.*

Tömösváryella singula Hardy; *Nisia atrovenosa* (Leth.); and various Heteroptera, most of which have egg-parasites.

Bruniquel (S.). **Recherches préliminaires sur la biologie d'un nouvel ennemi du caféier *Alcidodes bruniqueli* Roudier (Coleo. Curculionidae).** —*Agron. trop.* **12** no. 2 pp. 209–213, 3 figs., 7 refs. Nogent-sur-Marne, 1957. (With Summaries in English & Spanish.)

Roudier (A.). **Un *Alcidodes* nouveau d'Afrique équatoriale *Alcidodes bruniqueli* Roudier (Coleo. Curculionidae).**—*T. c.* pp. 214–216, 2 figs., 1 ref.

In the first of these papers, it is reported that gall-like swellings on the twigs of coffee (*Coffea robusta*) at Boukoko (Ubangi), first observed in 1952–53, were found to be caused by a weevil described in the second paper from adults of both sexes as *Alcidodes bruniqueli*, sp.n. Secondary infestations of ants and their eggs were found in some galls. Although plants were attacked regardless of their situation, those in wooded surroundings or near water seemed to be preferred to those in more open or dry country. The adults feed on the bark of the current year's growth and on the petioles. The eggs are inserted into the twigs, in which the larvae develop, causing the formation of galls. The end of the twig is not killed, but may break off, and flowering and fruiting are noticeably diminished.

Laboratory and cage tests showed that development is completed in 90–140 days. The egg, larval and pupal stages lasted about a week, 100 days and 12–13 days, respectively. Not more than two larvae were found in a single twig, and the ratio of males to females was 4:6. The weevil was parasitised by an Ichneumonid of the genus *Pimpla*.

Although not widespread in Ubangi, *A. bruniqueli* appears to be spreading. Many abortive galls are found, some possibly arrested in development by the action of parasites, but the majority probably by lignification of the twig; it is possible that there are native plants on which the insect develops without severe losses due to this and that infestation of coffee is a recent development.

Tapley (R. G.). **A possible Case of Coffee Thrips resistant to D.D.T.**— *E. Afr. agric. J.* **23** no. 2 pp. 82–83, 5 refs. Nairobi, 1957.

DDT, which had given satisfactory control of *Diarthrothrips coffeae* Williams on coffee in Tanganyika for about seven years, was still effective in 1956 in the Kilimanjaro region, where a 0·1 per cent. emulsion spray gave satisfactory control for a month, but failed at Oldeani. There, a small test in late November, in which sprays were applied at a high rate per tree, showed that treatment with 0·1–0·4 per cent. DDT reduced populations initially, but that newly-hatched nymphs did not succumb to the residues from 0·1 or 0·2 per cent. DDT, though they were destroyed by those from 0·4 per cent. sprays; the latter were estimated as 6·1 mg. per sq. ft. after eight days, as compared with 0·3 mg. from the lower doses. Adult thrips seemed to be relatively unaffected by the lower doses and were quite numerous again eight days after the application of the highest one. Sprays of 0·1 per cent. wettable Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] and of 0·05 per cent. parathion or dieldrin in emulsion formulation gave very good control until the eighth day, when the numbers of adults and nymphs were rising. Dieldrin is usually considered to be as persistent as DDT, and the rise in numbers of nymphs on the eighth day was possibly due to an increased tolerance of insecticides in general, caused by repeated exposure to DDT. This effect is referred to as vigour tolerance.

Whalley (P. E. S.). **The Banana Weevil and its Control.**—*E. Afr. agric. J.* **23** no. 2 pp. 110–112, 1 fig., 10 refs. Nairobi, 1957.

Cosmopolites sordidus (Germ.) has long been known to attack banana in Uganda, and its habits are reviewed from a paper previously noticed [*R.A.E.*, A **37** 363]. It is now present throughout the country, except near Fort Portal (Western Province), but is rare in the West Nile area (Northern Province). Recent investigations have shown that the living plant is also attacked by another weevil, *Temnoschoita nigroplagiata* (Qued.), which occurs throughout Uganda and is particularly abundant where *C. sordidus* is absent or rare. Rotting pseudostems are infested by *T. basipennis* Duv. and *T. erudita* Duv., both of which occur in the Western Province. The larvae of all these weevils are very similar, and they have probably been confused in the past; characters differentiating the larvae and pupae of *Temnoschoita* and *Cosmopolites* are given in a table. Larvae of *C. sordidus* rarely form cocoons, whereas those of *T. nigroplagiata* always do so.

Tests near Kampala on the control of *C. sordidus* showed that a 0·5 per cent. dieldrin dust, shaken on the stools round the base of the pseudostems and on the cut surfaces of split pieces of pseudostem or rhizome, which are then exposed on the ground, cut side down, as traps, gives the easiest and safest control. About five acres of banana plantation were successfully treated at 35–112 lb. dust per acre, depending on the number of stems per stool and the number of poisoned traps used. The dieldrin was still effective after two and a half months, in spite of very heavy rain, and it is considered that 2–3 applications at equal intervals in the first year of treatment, followed by one in each subsequent year, would give adequate protection.

Robinson (J.) & Mesmer (E. T.). **The Persistence of Insecticides Deposits applied to the Bark of Coffee Trees** (*Coffea arabica*). **I. DDT Deposits.** —*E. Afr. agric. J.* **23** no. 2 pp. 130–134, 5 graphs, 1 ref. Nairobi, 1957.

The results are given of experiments carried out to obtain accurate information on the persistence of DDT deposits, applied for the control of *Anthores leuconotus* Pasc. to the trunks of coffee trees in the Kilimanjaro area of Tanganyika [*cf. R.A.E.*, A **44** 191]. Lengths of trunk were sprayed to run-off with a 2 per cent. DDT emulsion spray, with or without the addition of resin, and samples cut at intervals were washed with light oil to remove the surface deposit, after which the bark, cambium and upper surface of wood were removed separately and subjected to extraction with the oil. Preliminary tests showed that determination of the DDT in these extracts by the hydrolysable chlorine method would give only approximate results, but that the experimental error would probably be less than 10 per cent. In all tests, the total DDT content decreased rapidly during the four weeks after application, but the rate of loss decreased with increasing time, and a total deposit of approximately 300 mg. per sq. ft. was present after 40–50 weeks. There appeared to be very little difference between the rates of loss from the surface and from the bark itself. There was no evidence that losses were due to translocation of DDT in the tree or to rainfall, and it was probably caused by volatilisation of the insecticide. The amounts found in the cambium and wood were very small and probably due to contamination from the bark, and this was supported by observation of the penetration of dyed emulsions, which reached only the outer layer of bark at doses equal to those used for DDT treatment. It is concluded that the trees can be protected against attack by *A. leuconotus* for several months if conditions are suitable.

Smithers (C. N.). **The recent Outbreak of Ladybird (*Epilachna similis* Thb.) on Maize in Southern Rhodesia.**—*Rhod. agric. J.* **54** no. 4 pp. 332–336, 4 figs., 2 refs.; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1930, 7 pp., 4 figs., 2 refs. Salisbury, S. Rhod., 1957.

An outbreak of *Epilachna similis* (Thnb.), which feeds on many graminaceous plants, occurred on maize in Southern Rhodesia in January 1957. All stages of this Coccinellid are briefly described. Both larvae and adults skeletonise the leaves, causing weakening of the plant and poor cob formation. Damage was first observed at the margins of the fields, suggesting that the insects had migrated from neighbouring wild grasses, and adequate control was given in tests by sprays of dieldrin, toxaphene or malathion; DDT had previously been shown to be ineffective. No other Coccinellid is known to attack maize in Rhodesia.

Toms (A. M.) & Goodman (A.). **The Importance of Drift in Insecticide Spraying Experiments: some Observations from Insect Behaviour in Cotton.**—*Emp. Cott. Gr. Rev.* **34** no. 3 pp. 177–188, 2 graphs, 15 refs. London, 1957.

Routine spraying experiments with DDT to control *Empoasca lybica* (de Berg.) on cotton in the Sudan Gezira have sometimes failed to show significant increases in yield of seed cotton, and it has been suggested that this is due to movement of the Cicadellids from unsprayed to sprayed plots, and consequent depletion of the population on the former. Local conditions in the area, including wind speeds of 6–10 miles per hour on most days of the spraying season (October) and thermal up-currents preventing the rapid settling of small droplets, favour the drift of DDT sprays for relatively long distances, and as the nymphs of *E. lybica* are susceptible to small doses of DDT, it is considered that a reduction of population on unsprayed plots is more likely to be due to spray drift.

Experiments carried out in 1955–56 showed that nymphal populations were significantly lower in plots downwind from one treated with 0·2 per cent. DDT in an emulsion spray than in those upwind of it and that a spray containing a blue dye drifted for distances up to about 160 ft. when applied in a wind blowing at 6–7 m.p.h. When the wind speed was 7–8 m.p.h., applications of about 0·5 or 1 lb. DDT per acre gave effective control of nymphs of *E. lybica* and initial reductions in the numbers of adults of *Bemisia tabaci* (Gennadius), whereas 0·1 lb. did not, except in plots to leeward of more heavily sprayed ones. It is concluded that spray drift may have a considerable effect on experimental results. Further instances of its effect are recorded, and precautions to be adopted in spraying and dusting experiments are suggested.

Emsley (M. G.). **A coarse Method of estimating Mirid Populations in the Field.**—*Emp. Cott. Gr. Rev.* **34** no. 3 pp. 191–195, 2 graphs. London, 1957.

As Mirids are active and easily disturbed, they frequently avoid capture or escape from it during normal sweeping of vegetation with an insect net, and methods of obtaining accurate estimates of their numbers on cotton were investigated in Nigeria in 1956. The catches of two unidentified species of *Campylomma* made in 4–5 successive sweeps per marked plot of about 120 sq. yards in separate tests on four days in September and October were plotted as successive cumulative totals, and the presumed total populations estimated by extrapolation of the resulting curves. The results

showed that some 36 per cent. of the estimated total population was caught in the first sweep and about 60, 76, 85 and 91 per cent., respectively, in the first two, three and four and all five sweeps, whether the numbers were large or small. It is concluded that only a single sweep is necessary for an accurate estimate.

Backlund (H. O.). **Aspects and Successions of some Grassland Vegetation in the Rukwa Valley, a permanent Breeding Area of the Red Locust.**—*Oikos* suppl. no. 2, 132 pp., 35 figs., 2 refs. Copenhagen, 1956.

Detailed descriptions are given of the plant communities in 19 representative grassland areas in the North Rukwa Valley, Tanganyika [*cf. R.A.E.*, A **44** 153], with accounts of the seasonal and successional changes, all of which were studied in relation to the ecology of the red locust [*Nomadacris septemfasciata* (Serv.)].. The seasonal changes in the vegetation are determined by climatic factors that affect the growth of different species in different ways, but tend to produce relatively small bare areas among taller vegetation, especially at the end of the dry season. These changes are considerably modified by burning, and the seasonal aspects of communities that have and have not been recently burned are described. The effects of fire vary according to the plant species present, the age of the community, and the season, but burning tends in general to produce large bare areas on which a uniform plant cover develops more rapidly than on natural open patches and to stimulate the growth of perennial species, even during the dry season. Neither provides conditions very favourable for locust oviposition and hatching, but when the burning is carried out irregularly and incompletely, as at present, it encourages the development of plant mosaics, which appear to be essential for the locusts [*loc. cit.*]. It is concluded from the general instability of the vegetation that it more nearly represents a series of fire climaxes than of edaphic or climatic ones, and it is suggested that a more uniform type of cover, less favourable to the locusts than the mosaics, would probably derive either from complete protection from fire, which appears to be impracticable, or from the regular firing of large areas.

Backlund (H. O.). **Red Locusts and Vegetation.**—*Oikos* **6** (1955) fasc. 2 pp. 124–148, 8 figs., 11 refs. Copenhagen, 1956.

The author describes the relatively small areas of grassland in Tanganyika and Northern and Southern Rhodesia to which *Nomadacris septemfasciata* (Serv.) is restricted between outbreaks [*cf. R.A.E.*, A **44** 153, 192], and discusses the microclimate provided by the vegetation in them, which is mostly of the mosaic type, in relation to the ecological requirements of the developmental stages of the locust [*cf.* **45** 497].

Maturation of the adults is retarded by the cool, dry weather that precedes the rains, but, in October and November, increased temperature and humidity and, possibly, the ingestion of dew, which then becomes available, induce sudden and simultaneous maturation [*cf.* **46** 252]. The locusts then congregate on patches of bare soil, to which they may be attracted by light [*cf.* **41** 236], for pairing and oviposition. Bare areas are often caused by fires, but, if large, these are probably less favourable for oviposition [*cf.* preceding abstract]. The eggs are deposited in bare soil near the tall grass in which the locusts roost at night, but if the rains that induce oviposition are slight and the soil again becomes hard, the females oviposit on the outskirts of the grass stands or migrate to softer soil, such as sand or silt; heavy clay soils, which form a hard crust in dry weather, are thought to provide the best protection of the eggs from desiccation [*cf.* **46** 253]. By the time the

hoppers hatch, the former bare patches are more or less covered by young growths of *Cyperus* [*cf.* **39** 411] and other plants, which provide food and shelter. Most of the development of the hoppers takes place during the rains, when temperature and humidity within and without the vegetation are uniformly high and very similar and the vegetation is sufficiently dense to provide shelter from the sun. The adult stage coincides almost entirely with the dry season. During June–August there are marked diurnal fluctuations in temperature and humidity, and the climate within the vegetation differs markedly from that outside. The young adults bask on bare patches, tracks and low vegetation, but physiological changes that occur in July cause this habit to be abandoned until after they have matured, when the high temperatures on the patches induce great activity. Within the stands of tall grass in mosaics that comprise the main habitat of the adults, there is a stratified microclimate that enables the locusts to shelter during the day at the most appropriate level; they roost at night on projecting tall stems or isolated small stands of tall grass and thus avoid the cooling effects of radiation from the main dense vegetation. They probably feed on the low grasses that form a layer beneath the tall ones. The preference shown for stands of *Echinochloa pyramidalis*, which is not a preferred food-plant, is attributed to the favourable conditions provided in them at the beginning of the dry season, when the upper leaves adopt a horizontal position, thus forming a more or less enclosed space, shaded from the sun, in which the air is moist and warm with a stratified temperature by day and an even one by night. Locusts have been observed to remain in these spaces at night, climbing up the projecting tall stalks only with the first rays of the sun. For individuals in the solitary phase, which are not very mobile [*cf.* **45** 498], habitats that fulfil the varying requirements of the locusts are available only in vegetation mosaics or, in areas where these are few or absent, in vegetation associations showing marked contrasts, such as those bordering rivers.

It has been thought that incipient swarms develop in the outbreak areas through the building up of numbers over successive generations. In years between outbreaks, however, concentrations of hoppers may arise at obstacles that impede their progress in the direction of the lie of the grass [*cf.* **39** 412] and of adults at the down-wind edge of stands of tall grass. Disturbances, such as fires, cause further movements, which, owing to the mutual stimulation of the locusts, are faster than those of solitary individuals. In the Rukwa Valley of Tanganyika, this leads to ultimate concentrations at the edge of the dense woodland bordering the grass plains. If these become large enough for swarm behaviour to be initiated, the circling swarmlets may eventually be carried over the escarpment by upward currents of air [*cf.* **45** 498] and become migrating swarms.

Uvarov (B. P.). **The Aridity Factor in the Ecology of Locusts and Grasshoppers of the Old World.**—[*In*] Arid Zone Research: Human and Animal Ecology pp. 164–198, 308 refs. Paris, UNESCO, 1957. (With a Summary in French.)

Since locusts and grasshoppers are most injurious in regions with arid or semi-arid climates and are associated with open, dry habitats, the author discusses the distribution, seasonal cycle, and ecology of the species of importance in Europe, Africa, Asia and Australia in relation to aridity. Locusts are favoured by vegetation mosaics interspersed with patches of bare soil [*cf.* preceding abstract] and in consequence are most numerous at the zone of contact between two types of plant cover (ecotone), where such mosaics usually develop [*cf. R.A.E.*, A **44** 153]. Deforestation,

grazing, and shifting cultivation have greatly extended the areas with a mosaic-type vegetation [**24** 445; **35** 134; **38** 45], and since they have usually favoured the dry component, large new areas have become accessible to locusts. Both natural ecotones and artificially created semi-arid habitats are unstable and vary with normal annual fluctuations in weather [*cf.* **44** 153]. Although most Acridids are favoured by drought, the influence of annual climatic variations is particularly striking in locusts, among which local aridity can initiate outbreaks by reducing the available vegetation, thus leading to concentration and the subsequent appearance of the gregarious phase, and seasonal aridity can initiate migration by drying up ephemeral vegetation and enforcing movements between areas with and without plant cover. The effects of weather are largely modified by the vegetation, both as a source of food and through the microclimate within it [*cf.* preceding abstract], and no direct correlation between Acridid population dynamics and any general index characterising weather therefore appears possible, though the use of bioclimatographs based on the meteorological factors that affect each stage in the life-cycle shows promise as an empirical method.

Williams (J. R.). **The Sugar-cane Delphacidae and their natural Enemies in Mauritius.**—*Trans. R. ent. Soc. Lond.* **109** pt. 2 pp. 65–110, 11 figs., 50 refs. London, 1957.

In view of the risk of introduction of the Fiji disease of sugar-cane from Madagascar [*cf. R.A.E.*, A **45** 171] into Mauritius, where it does not at present occur, and the importance of *Perkinsiella saccharicida* Kirk. as a potential vector in the latter island, investigations were made on the bionomics and economic importance of this species and of *Dicranotropis muiri* Kirk., the only other Delphacid found breeding on sugar-cane there. The immature stages of these two and of *Peregrinus maidis* (Ashm.), which occasionally occurs on the crop, are described. Observations over two years showed that both *Perkinsiella* and *Dicranotropis* are widely distributed in Mauritius but rarely numerous, though more so in the dry, warm, low-lying districts than in cool, wet areas at altitudes above 1,000 ft. Young plant cane and varieties with broad arching leaves were preferred. The bionomics of the two species are similar. Eggs are laid in the thicker part of the leaf blade, especially in the upper surface of the mid-rib, or in the leaf sheath, provided that it is not densely pubescent, singly by *D. muiri* and in small groups by *P. saccharicida*. The nymphs shelter by day in moist, shady situations, mostly near the base of the plants, and the adults in drier situations, those of *P. saccharicida* commonly within the bases of the newly opened leaves or on the stalks or leaf sheaths and those of *D. muiri* on the lower surface of the leaves. In the laboratory, at about 25°C. [77°F.], the development of *P. saccharicida* lasted 45–50 days and that of *D. muiri* slightly less; the eggs of both hatched in 11–15 days. Direct injury, which, however, does not appear to affect plant growth, comprises the removal of plant juices during feeding by nymphs and adults and mechanical damage during oviposition, which is frequently followed by invasion of the tissues by the red-rot fungus, *Glomerella* (*Physalospora*) *tucumanensis*. No plant other than sugar-cane was attacked in the field. Control by natural enemies, which are numerous, appears to be mainly responsible for the low populations. Both species are preyed upon by spiders, and both are parasitised by *Ootetrastichus pallidipes* Perkins, *Paranagrus optabilis* Perkins, and *Anagrus flavcolus* Waterh., which attack the eggs, *Pseudogonatopoides mauritianus* Williams, which parasitises the nymphs, and *Dorilas mauritianus* Hardy, which develops in the nymphs and adults and causes sterility

or reduced fertility and early mortality of the latter. A Strepsipterous parasite, *Elenchus templetoni* Westw., also causes sterility or reduced fertility and nymphal and, possibly, early adult mortality of *Dicranotropis*; it readily attacks *Perkinsiella* but is unable to complete normal development in it. Descriptions of the larvae and puparium of *Dorilas* and *Elenchus* and the adult female of the latter, with the persistent larval integument (referred to as the pseudopuparium), and accounts of the bionomics of both parasites and of their effect on the host, are included.

Gurr (L.). **Observations on the Distribution, Life History, and economic Importance of** *Nysius huttoni* **(Lygaeidae: Hemiptera).**—*N.Z. J. Sci. Tech.* **38** (A) no. 7 pp. 710–714, 14 refs. Wellington, N.Z., 1957.

Nysius huttoni White is widely distributed in New Zealand, where it attacks wheat, many other cultivated plants, and weeds. Observations in the South Island during 1951–53 showed that it prefers hot, dry habitats, in which the vegetation permits the sunlight to reach the ground. The Lygaeid shelters under clods or débris on the soil, except during the warmest parts of the day, and also during rain. The adults overwinter under vegetable litter and at the bases of plants, and were present in the field until 14th May in 1952 and 1953; second- and fifth-instar nymphs were present until 8th April and 12th May, respectively. Adults appeared in the field on 14th September in 1951 and 19th September in 1952, and pairing took place between October and early March. Eggs were found only in cracks in the soil. Females each confined with a male in a tube plugged at one end with cotton-wool and kept in an open insectary laid eggs singly on the cotton-wool or in groups in it at depths of up to 3 mm. The preoviposition and oviposition periods of nine females lasted 3–11 and 1–43 days, respectively, and totals of 1–174 eggs were laid; the maximum laid by one female in one day was 30. An unmated female laid 76 eggs in 43 days, but they did not develop. The mean duration of the egg stage and of the five nymphal instars, in order, was 9·5, 6, 5, 17, 15, and 14 days, respectively.

Although *N. huttoni* is one of the Hemiptera responsible for the condition in wheat grains known as "sticky dough" or "slimy gluten" [*cf. R.A.E.*, A **27** 548] and 7 per cent. of 1,400 samples of wheat were damaged in this way in 1950, it is of greatest economic importance as a pest of crucifer seedlings. Damaged wheat germinates normally and can be used for poultry food, and flour milled from it can be mixed with sound flour at rates of less than 1 per cent. without impairing the baking qualities. The only effect of heavy infestation on yield appears to be an increase in the percentage of second-grade wheat, and owing to the dense growth of wheat crops, the weeds on which the Lygaeid feeds until they dry out and, in consequence, infested wheat plants, are largely confined to the margins. On cruciferous seedlings, feeding punctures at the base of the stems cause a cankerous growth that interferes with sap flow and may result in the collapse of the plant.

Todd (D. H.). **Incidence and Parasitism of Insect Pests of cruciferous Crops in Hawke's Bay, Wairarapa, and Manawatu, 1955–56.**—*N.Z. J. Sci. Tech.* **38** (A) no. 7 pp. 720–727, 1 map, 3 refs. Wellington, N.Z., 1957.

The following is based almost entirely on the author's summary of this account of observations in 1955–56 on the incidence of *Pieris rapae* (L.), *Plutella maculipennis* (Curt.) and *Brevicoryne brassicae* (L.) and their parasites [*cf. R.A.E.*, A **34** 323; **36** 244] on 36 cruciferous crops in the three

main areas in which these are grown in the North Island of New Zealand. Little damage was observed on the crops. A virus wilt disease, common in all districts, reduced populations of *Pieris rapae* to such a level that only small numbers of healthy larvae could be collected. The larval parasite, *Apanteles glomeratus* (L.), was not recovered, but where pupae could be collected, they were heavily parasitised by *Pteromalus puparum* (L.). Incidence of *Plutella* was low in all areas, and the prepupae and pupae collected were heavily parasitised by *Angitia cerophaga* (Grav.), adults of which were frequently seen. Considerable numbers of *B. brassicae* were attacked by *Diaeretus rapae* (Curt.), which was apparently introduced with the Aphid, and a hyperparasite, *Lygocerus niger* (How.), was also reared from it. *D. rapae* is of little value in checking populations, partly owing to hyperparasitism, and *B. brassicae* is potentially the most serious pest of cruciferous crops.

Wise (K. A. J.). **Trials for Control of Chrysanthemum Gall Midge (*Diarthronomyia chrysanthemi* Ahlberg).**—*N.Z. J. Sci. Tech.* **38** (A) no. 7 pp. 728–734, 1 fig., 2 refs. Wellington, N.Z., 1957.

Diarthronomyia chrysanthemi Ahlberg was recorded on chrysanthemum in Auckland, for the first time in New Zealand, in 1953 [*cf. R.A.E.*, A **44** 396]. It subsequently spread throughout that area and further to the south and may now occur throughout the North Island. In this paper, information, largely from the literature, is given on the bionomics of this Cecidomyiid and the damage caused by it [*cf.* **28** 298; **31** 283], followed by the results of experiments on control.

In preliminary tests with sprays in 1953–54, parathion gave effective control, γ BHC and nicotine sulphate were of some value, and DDT and schradan were ineffective. In 1954–55, sprays were applied weekly or fortnightly over a period of ten weeks to initially uninfested chrysanthemums that were kept in an insectary with heavily infested plants. Weekly applications of 0·025 and 0·0125 per cent. parathion gave the best protection against attack (90·5 and 85·1 per cent., respectively) and complete control of such infestations as developed; fortnightly applications gave 28·3 and 23 per cent. protection and 99·6 and 95 per cent. control, respectively. Weekly applications of nicotine sulphate at 0·1 per cent. gave partial protection and are recommended where the risk of poisoning by parathion is considered excessive. The control obtained with nicotine sulphate at 0·08 per cent. and with γ BHC applied either fortnightly or weekly was inadequate, and DDT was ineffective. In another test, in which the sprays were applied three times at weekly intervals to heavily infested plants, parathion gave 92·3 and 85·8 per cent. control at 0·025 and 0·0125 per cent., nicotine sulphate gave poor control at 0·1 per cent., and DDT and γ BHC were ineffective.

A wide range of susceptibility to attack was found among 43 varieties of chrysanthemum tested in 1953–54. None was immune, but infestation on three was light.

Palmer-Jones (T.), Forster (I. W.) & Griffin (L. A. M.). **Effect on Honey Bees of Metasystox applied from the Air as a Spray to Chou Moellier.**—*N.Z. J. Sci. Tech.* **38** (A) no. 7 pp. 752–769, 5 figs., 9 refs. Wellington, N.Z., 1957.

The following is based on the author's summary of this account of experiments to determine the effect on honey bees of Metasystox (dimethyl

2-(ethylthio)ethyl phosphorothioate [methyl-demeton]) applied to cruciferous seed crops against Aphids in New Zealand. Metasystox was applied in an emulsion spray from the air to 11 acres of marrow-stem kale (chou moellier) in flower, at a rate estimated at 16 fl. oz. per acre, in the evening when no bees were flying. Before the application, bees from a neighbouring experimental apiary were collecting nectar and pollen extensively from the crop. The spray killed virtually all foraging bees within two days, and nectar in the kale flowers was shown to be toxic to bees for five days after spraying. All bumble bees (*Bombus* spp.) visiting the crop were killed. It is concluded that plants that have flowers attractive to bees should not be sprayed with Metasystox for at least a fortnight before they flower.

Friend (A. H.). **Artificial Infestation of Oranges with the Queensland Fruit Fly.**—*J. Aust. Inst. agric. Sci.* **23** no. 1 pp. 77–80, 2 figs. Sydney, 1957.

An injection method for the artificial infestation of oranges with eggs of *Dacus* (*Strumeta*) *tryoni* (Frogg.) was devised in Australia during work on procedures for freeing *Citrus* fruits for export from infestation, for which supplies of naturally infested fruits were not adequate. Preliminary investigations with placement by means of a scalpel showed that the eggs and young larvae were killed by contact with the oil of the fruits and, in winter, young larvae did not survive in the pith (in which the eggs are normally laid) of main-crop Late Valencia oranges or Eureka lemons, though they developed normally in that of Wheeley grapefruits, old second-crop Late Valencia oranges, and Washington navel oranges; larval development was normal when the eggs were placed close to the juice or juice cells.

In the injection method, ovipositing females were provided with an inverted wax-paper or plastic cup sealed to a glass plate, on which a piece of fruit was enclosed as an attractant, and deposited their eggs through needle holes pierced in the side of the cup. Several thousand eggs were obtained in this way in a few hours, and, after washing to the bottom of the cup and storage, covered with wet cotton-wool, for two days at 40°F., they were introduced at the rate of 500 per ml. into a broken agar gel, prepared by stirring a solution of 0·4 per cent. powdered agar in warm distilled water, adding a preservative and 1 per cent. orange juice, and, when set, pressing through muslin; cultures of micro-organisms that assist establishment of the larvae were also added. The egg suspension was injected into the fruits by means of a hypodermic syringe provided with a flat collar and fitted with a 20-gauge needle, of which the orifice at the tip was blocked and a new one made at the side, immediately behind the tip bevel, to prevent clogging by the fruit fibres. During injection, the fruit and the syringe were supported in an apparatus that allowed both the dosage and, within the limits of the needle employed, the depth at which it was placed in the fruit, to be controlled, and the treated fruits were stored at 85°F. in a dry atmosphere. Under these conditions, early maturing larvae often left the fruits seven days after the introduction of the eggs. To prevent the development of moulds on the fruits during storage, they were surface-sterilised before use, the needles and equipment used for handling the eggs were sterilised in boiling water, the injection wound, enlarged for the purpose by means of a small metal collar round the proximal end of the needle shank, was plugged with a suitable mixture, and the treated fruits were wrapped in coverings impregnated with diphenyl during incubation.

The injection method was adapted for use with apples by soldering a small metal flange to the non-bevel side of the needle tip, which, when the apple was revolved after insertion of the needle, excavated a small cavity for the

accommodation of the suspension. Eggs developed satisfactorily when placed in the core cavities, but the young larvae did not always escape successfully.

Wilson (G.). **Control of the Cane Grub Pests,** *Dermolepida albohirtum* **Waterh. and** *Lepidiota frenchi* **Blkb. by Benzene Hexachloride.**— *Tech. Commun. Bur. Sug. Exp. Stas Qd* 1956 no. 2 pp. [2+] 13–41, 3 figs., 10 refs. Brisbane, 1956.

Experiments with crude BHC (13 per cent. γ isomer) were carried out in sugar-cane fields in northern Queensland in 1949–56 in an attempt to improve existing recommendations for the control of *Dermolepida albohirtum* (Waterh.) [*cf. R.A.E.*, A **38** 89, 137–138, 405] and to extend the use of this material for the control of *Lepidiota frenchi* Blkb., which is less susceptible to it. The investigations were often hampered by the scarcity of *D. albohirtum* after 1950, which is attributed to the widespread use of BHC. A single application of a 10 per cent. BHC dust at 150 lb. per acre to the soil on either side of the cane row was previously recommended for protection of the plant and two subsequent ratoon crops, but in the present tests, treatment with a 20 per cent. dust, already in use among growers, at 75 lb. per acre gave equally effective protection of plant and first ratoon crops and was less costly; the effect on the second ratoon crops could not be assessed owing to the absence of infestation. In an area where a small population of third-instar larvae of *L. frenchi* was also present, a 50 per cent. BHC dust was as effective at 30 lb. per acre as the 20 per cent. dust at 75 lb., and at 20 lb. per acre it was as effective as the 20 and 10 per cent. dusts at 50 and 100 lb., respectively. There was no significant difference in the protection given when dusts prepared from refined BHC (66 per cent. γ isomer) were used instead of the crude material.

When applied in the drill at planting time, which is the practice adopted by growers for the control of *L. frenchi*, the dust was more effective against larvae of *D. albohirtum* when placed just above rather than just below the setts; in the latter position, it seriously impaired sprouting, whether applied alone or mixed with fertiliser, unless it was separated from the setts by a thin layer of soil [*cf.* **38** 137]. It was no less effective in control when combined with a fertiliser, but subsequent yields were lower, since the presence of the BHC prevented the roots from entering the treated area. There were no significant differences in yield when the full rate of BHC was applied to the plant crop or when half was applied to the plant crop and half to the subsequent first ratoon crop. In tests on a light soil, significantly higher yields were obtained from the plant crop when the rate of application of the 10 per cent. dust was increased from 75 or 100 lb. per acre to 150 lb., which was as effective as the 20 per cent. dust at 75 lb. per acre, but not from the first ratoon crop when the rate of application of the 10 per cent. dust to the plant crop was increased from 150 to 200 lb. per acre. In long-term tests in progress in various parts of Queensland on soil of different types, repeated applications of crude BHC, refined BHC (88 per cent. γ isomer) and γ BHC as lindane in the absence of soil pests showed no deleterious effects on either yield or sugar content during the first three years. Other tests indicated that although the sugar content of cane damaged by larvae was higher under certain conditions than that of undamaged cane, there was no increase in the yield of sugar per acre or in the net profit. There was no evidence that treatment with BHC prevents oviposition by *D. albohirtum*.

Third-instar larvae of *L. frenchi* in the plant crop were controlled by the 20 per cent. BHC dust applied at 75 lb. per acre with fertiliser in the

drills at planting time after the setts had been lightly covered with soil, and the 10 per cent. dust applied to the plant crop at 150 and 200 lb. per acre adequately protected the first ratoon crop against first-instar larvae.

Carne (P. B.). **An ecological Study of the Pasture Scarab** *Aphodius howitti* **Hope.**—*Aust. J. Zool.* **4** no. 3 pp. 259–314, 2 pls., 13 figs., 25 refs. Melbourne, 1956.

The following is based almost entirely on the author's summary of this account of studies on the ecology and abundance of *Aphodius howitti* Hope in south-eastern Australia [*cf. R.A.E.*, A **31** 264; **39** 39], where this Aphodiid has become numerous in pastures, largely as a result of the great increase in pasture improvement and in stocking rates over the past 25–30 years. It has only one generation a year. Females were found to lay their eggs in two batches, one, of about 35 eggs, before feeding in dung and sometimes even before flight, and the other, of about 15 eggs, after feeding. The presence of dung is therefore not necessary for the survival of the species, which is often abundant in ungrazed turf. Detailed studies of flight activity showed it to be initiated by light of a particular intensity, and the time of appearance of adults in flight could be accurately forecast in relation to sunset. Flights are favoured by high temperature, high soil moisture, and low wind velocity. Unfed adults fly upwind towards dung pads. Gravid females execute a circling, exploratory flight; they appear to seek out comparatively bare situations for oviposition and usually enter the soil through small cracks such as are made by the germination of subterranean clover (*Trifolium subterraneum*). When the weather is unfavourable for flight, the females sometimes oviposit where they emerge, and this may account for the observed tendency for particular sites to support dense populations in successive seasons. Under more favourable conditions, most females fly before ovipositing, and, like others ovipositing for a second time, they may select previously uninfested sites. Females outnumbered males among both field-collected and laboratory-reared adults.

The larvae move freely and at random over the soil at night when the weather is favourable, excavating burrows when they find suitable plants or pieces of dung, and the soil thrown up by third-instar larvae may be sufficient almost to conceal short pasture [*cf.* **46** 239]. Larval development is more rapid in light soils, especially those rich in organic matter, and on a diet of leguminous plants than on one of grasses alone. The species appears to be unable to take advantage of temporary amelioration of conditions in districts marginal to its permanent geographical limits of distribution, though it may be locally very abundant close to these limits. In unimproved native pastures, it is rare except in or near stock camps. Its occurrence in large numbers is determined more by the composition and density of the vegetation of a pasture than by factors such as the pH value or the content of organic matter of the soil. Very heavy soils are avoided, and pastures that have been established for less than 2–3 years are rarely damaged.

The upper slopes and tops of rises in undulating country and, sometimes, in exceptionally dry seasons, slight depressions are preferred for oviposition. Where this has been intense, the larvae move out laterally during their development and accumulate on circular fronts about their point of origin. Oviposition tends to be particularly intense about conspicuous objects such as trees and fences [**39** 40], and is often patchy, even in flat, uniform pastures, but there is no indication that ovipositing females fly in swarms.

The major factors limiting populations are destruction of the larvae by one another in combat while foraging on the surface, and fungus disease,

notably that caused by *Cordyceps aphodii*. The first factor appears to act as a powerful density-stabilising mechanism, in that, irrespective of initial larval densities above about 10 per square link, the density of the immature adults produced is approximately constant. Fungus diseases occur in all parts of the range of *A. howitti*, and, in patches where the latter is numerous, sufficient spores may be produced in the soil to cause high mortality among larvae of the succeeding generation. Other factors that affect the larvae include desiccation and drowning, infection by nematodes (*Mermis* sp.), destruction by birds and Asilid and Carabid larvae, and parasitism by Thynnids (*Tachinomyia* sp.), but none is considered to be of significance in regulating numbers. Other factors that influence populations include the distribution of favourable oviposition sites, a bacterial disease that infects larvae injured in combat with one another, and weather factors that directly and indirectly influence the intensity of larval combat. The development of high numbers is favoured by evenly distributed rainfall during the larval stage. On the southern tablelands of New South Wales, falls in excess of 4 ins. in any month are unfavourable. Catches of adults in light-traps at Canberra were large in years when rainfall was below average and small when it was above.

The damage caused by infestation [*cf.* **46** 239], which is discussed, includes the facilitation of soil erosion and ill effects on the health of grazing stock through the ingestion of soil. Possible ecological methods of control, which are also discussed, include the greater use of hardy perennial pasture species, or the adoption of a ley system of farming in which susceptible pastures (with predominating subterranean clover) form a three- or four-year course in a rotation involving ploughing [**31** 264] and cropping. Grazing management practices might be so modified as to reduce the attractiveness of pastures to ovipositing females.

MADGE (P. E.). **The Ecology of *Oncopera fasciculata* (Walker) (Lepidoptera: Hepialidae) in South Australia. I. Field Observations on the Numbers of *O. fasciculata* and the Factors influencing Birth Rate and Death Rate.**—*Aust. J. Zool.* **4** no. 3 pp. 315–326, 1 pl., 3 figs., 4 refs. Melbourne, 1956. **II. The Influence of Temperature and Moisture on Speed of Development and Survival Rate of the Eggs.**—*T. c.* pp. 327–345, 3 graphs, 5 refs. **III. The Influence of Temperature and Moisture on Survival Rate of the Larvae.**—*T. c.* pp. 346–357, 1 graph, 5 refs.

After the last outbreak of *Oncopera fasciculata* (Wlk.) in pastures in south-eastern South Australia in 1948–50, numbers remained low [*cf. R.A.E.*, A **44** 332] until 1954, when this Hepialid again became injurious. Field and laboratory investigations on the influence of the environment on its distribution and abundance were carried out during 1950–55, and an account of some of the work is given in these first three papers of a series. It is stated in the first of them that the end of the last outbreak coincided with a marked change in the weather, and that there was during 1949–50 a pronounced shift in the distribution of *O. fasciculata* from well-drained to low-lying, poorly drained soils, which may also have been influenced by the weather. The climate, topography, soils and vegetation of the area are described and the environmental factors that may influence survival of *O. fasciculata* discussed. Low temperature does not appear to affect the pupae or adults. The eggs and young larvae are susceptible to desiccation, and the older larvae, prepupae and pupae to excessive wetness or flooding. The larvae are unable to survive immersion for 48 hours, and in 1950 many were drowned by heavy rain and many of the survivors destroyed by birds.

Most pastures in the area have been improved by the use of exotic clovers and grasses, which form a dense cover and provide good shelter for the insect. Some native pastures, in which the vegetation is sparse and upright and there is a high proportion of bare ground, still exist, however, and these were rarely heavily infested. In a few places in 1950, larvae were sufficiently numerous to reduce the available food-supply to such an extent that considerable numbers starved, and this is attributed to the interaction between the vegetation, which mainly comprised annual grasses and clovers, and unusually dry weather in autumn and spring, which largely prevented regrowth. No specific predators or parasites of *O. fasciculata* were observed, but birds fed on larvae that left their burrows during the day and on adults on the ground, and Carabids destroyed the larvae.

In the second paper, it is stated that the years 1947–49 were characterised by unusually prolonged rain during October–December and that the rapid increase in numbers at the beginning of the outbreak might have been caused by an uncommonly high survival rate among the eggs and young larvae, which occur on or near the soil surface during September–December. The moisture and temperature requirements of the eggs were accordingly investigated. In the laboratory [*cf.* **44** 332], the constant temperatures most favourable for development were in the range 10–22°C. [50–71·6°F.] and no larvae hatched at 6·3 or 31·6°C. [43·34 or 88·88°F.]. Experiments, which are described, showed that the eggs are easily killed by dryness because they lose water rapidly when exposed to evaporation. In a laboratory test with eggs that had completed 15 per cent. of their development, loss of 43 per cent. of the water content resulted in 50 per cent. mortality. As the embryos developed, the eggs became more susceptible to water loss, and lost water could not be replaced when free water became available. The rate at which water was lost also had a significant effect on survival. High, dense plant cover appeared to be commonly associated with later damage to herbage by the larvae, and in a field experiment in which eggs were exposed on soil with different types of plant cover (chiefly *Trifolium subterraneum* and *Lolium rigidum*), most young larvae survived on a plot with high, dense cover, resembling that in improved pastures that have not been heavily grazed or cut for hay, and there were also significantly more larvae on a plot with high, sparse cover than in those in which the cover was low, whether it was dense or sparse. This is attributed to the protection from desiccation afforded by tall cover to the eggs.

The following is largely based on the author's summary of the third paper. In South Australia, *O. fasciculata* is found only in the higher-rainfall area in the south-east. Its distribution and numbers appear mainly to be restricted by hot, dry weather in late spring and early summer, when the eggs and young larvae are present, and experiments indicated that older larvae established in subterranean burrows resemble them in being better able to withstand dryness and heat where the ground is covered with dense herbage. In a laboratory experiment with unfed, first-instar larvae, 50 per cent. mortality followed the loss of only 7·1 per cent. water at 16·9°C. [62·42°F.]. Field observations indicate that the larvae remain virtually dormant during the summer but grow rapidly from about April. From the results of experiments described, it is concluded that the resumption of active feeding and growth is associated with the first substantial autumn rains combined with the availability of either dead or green vegetation as food. When rainfall is intermittent, the larvae feed more actively during wet periods and become relatively inactive during dry ones. The relative humidity of the air at the base of a subterranean burrow where the larva lives was usually above 95 per cent., even when the relative humidity of the air just above the mouth of the burrow was as low as 65 per cent. No

measurements were taken at the height of summer, when the burrows may have been drier than this.

Masaki (S.). **The Effect of Temperature on the Termination of Diapause in the Egg of** *Lymantria dispar* **Linné (Lepidoptera: Lymantriidae).** —*Jap. J. appl. Zool.* **21** no. 4 pp. 148–157, 8 graphs, 17 refs. Tokyo, 1956.

The eggs of *Lymantria dispar* (L.) are normally laid in summer, and the embryos develop for about a fortnight and then undergo a diapause until the following spring. Investigations on the effect of temperature on the termination of the diapause were carried out in 1953–55 with eggs from Hokkaido and Honshu.

Eggs collected in Hokkaido in August were kept in the laboratory until the end of September, after which they were subjected to a temperature of 5°C. [41°F.] for 20–160 days and then incubated at 26°C. [78·8°F.] or kept at 26°C. throughout. No eggs kept at 26°C. throughout the experiment and very few of those exposed to 5°C. for 40 days hatched within six months or more, whereas about 50 and 80 per cent., respectively, of those exposed to the low temperature for 70 and 80 days did so, and there was a further gradual increase until the exposure period reached three months; after 200 days, viability was apparently reduced, probably because the low temperature damaged eggs in which the diapause had been completed. The mean time required for incubation decreased from 22 days after exposure to cold for 70 days to 6·5 days after exposure for 160 days, and the variability in incubation period was reduced as cold exposure was prolonged.

When eggs collected in Honshu in the last week of October were subjected to temperatures of 0, 5, 12 and 15°C. [32, 41, 53·6 and 59°F.] for 80 days from the beginning of November, considerable numbers hatched, in mean periods of 25·1, 21·8, 22·7 and 23·8 days, respectively, when transferred to 26°C. The percentage hatch was greatest at 5°C. Only one of 200 eggs exposed to 20°C. [68°F.] and none of those exposed to 26°C. throughout the experiment hatched, and it is concluded that the optimum temperature for completing diapause is between 5 and 12°C. and the upper and lower limits about 20 and 0°C. Eggs collected in the two localities showed similar reactions to temperature; no attempts were made to determine the effect of humidity in terminating diapause, since it is known to have little effect on embryonic development or hatching [*cf. R.A.E.*, A **30** 233].

Sasa (M.) & Shigai (H.). **Studies on the Tarsonemid Mites in stored Food.** [*In Japanese.*]—*Jap. J. appl. Ent. Zool.* **1** no. 1 pp. 1–7, 4 figs., 9 refs. Tokyo, 1957. (With a Summary in English.)

A description is given of a Tarsonemid mite found breeding in stored food products and drugs in Japan. It could not be identified as any of the four species of *Tarsonemus* described from that country, and is thought to be *T. floricolus* C. & F.

Koshihara (T.) & Okamoto (D.). **Control of Rice Stem Borer by the Application of BHC Dust in the Paddy Field Soil.** [*In Japanese.*]—*Jap. J. appl. Ent. Zool.* **1** no. 1 pp. 32–35, 1 graph, 10 refs. Tokyo, 1957. (With a Summary in English.)

Since BHC is known to be absorbed by plants from the soil and translocated in them [*cf. R.A.E.*, A **46** 229, etc.], the effect on the rice stem

borer [*Chilo suppressalis* (Wlk.)] of applying a BHC dust to the soil in which rice is grown was investigated in Japan. Dusts containing 3 per cent. BHC or lindane [almost pure γ BHC] were incorporated at various rates into the soil just before the rice was transplanted, and observations made on subsequent infestation and plant growth. Good control of the first generation was given by either dust applied at about 80 or 160 lb. per acre, but none of the second generation, even at 1,600 lb. No plant injury was caused by treatment at the lower rates.

Hama-hama tanam-tanaman kita. I. Buku-gambar berwarna tentang hama-hama dan penjakit-penjakit jang terpenting pada: padi, katjang tanah, djagung dan kedelai. [The Pests of our cultivated Plants. I. Coloured Picture-book of Pests and Diseases of Importance for Rice, Groundnuts, Maize and Soy Beans.]—13½ × 9½ ins., 52 pp., 24 col. pls. Bandung & The Hague, W. van Hoeve, 1953.

Tjoa Tjien Mo. **II. Buku-gambar berwarna tentang hama-hama kelapa.** [II. Coloured Picture-book of Pests of Coconut.]—52 pp., 24 col. pls. Djakarta, Noordhoff-Kolff N.V., 1957. (Both obtainable from Balai Besar Penjelidikan Pertanian di Bogor.)

These two volumes form parts of a series on the pests and diseases of crop plants in Indonesia, and consist essentially of coloured plates supplemented by notes. Most of the pests are insects, and for these the plates illustrate the appearance and habitats of the various stages, feeding habits and the damage caused, and the notes contain information on morphology, bionomics, local distribution, parasites, and chemical control.

Brookes (R. F.), Clark (N. G.), Cranham (J. E.), Greenwood (D.), Marshall (J. R.) & Stevenson (H. A.). **The Toxicity of organic Sulphides to the Eggs and Larvae of the Glasshouse Red Spider Mite. IV. Benzyl Phenyl Sulphides (substituted by Halogens and other Groups).**—*J. Sci. Fd Agric.* **9** no. 2 pp. 111–115, 4 refs. London, 1958.

Brookes (R. F.), Cranham (J. E.), Greenwood (D.) & Stevenson (H. A.). **V. Benzyl Phenyl Sulphides (Non-halogen Substituents).**—*T. c.* no. 3 pp. 141–143, 12 refs.

Cranham (J. E.), Cummings (W. A. W.), Johnston (A. M.) & Stevenson (H. A.). **VI. Benzyl heterocyclic Sulphides.**—*T. c.* pp. 143–147, 10 refs.

Cranham (J. E.), Greenwood (D.) & Stevenson (H. A.). **VII. Benzyl Phenyl Sulphides (α-substituted).**—*T. c.* pp. 147–150, 8 refs.

These four parts of a series [*cf. R.A.E.*, A **46** 271] contain the results of further tests of substituted benzyl phenyl sulphides and related compounds against the eggs and young stages of *Tetranychus telarius* (L.). The compounds were synthesised by methods indicated and tested in the laboratory by the same methods as before [*cf.* **45** 421; **46** 272].

Some of the compounds dealt with in the first part were variations of the halogen-substituted benzyl phenyl sulphides, in which one of the halogen substituents was replaced by a non-halogen, whereas others consisted of the halogen-substituted sulphides with additional, non-halogen substituents. There was no appreciable activity when the benzyl moiety was unsubstituted, but considerable activity in some of the compounds in which the nucleus of

this moiety carried a p-chlorine substituent; compounds substituted by o- or m-methyl groups in the phenyl nucleus, in addition to p-chlorine atoms in both nuclei, were active, but less so than p-chlorobenzyl p-chlorophenyl sulphide (chlorbenside), and although p-chlorobenzyl p-hydroxyphenyl sulphide had negligible activity, alkylation of the hydroxy group resulted in a slight increase in activity in the methyl ether and a considerable increase in the allyl, 2-hydroxyethyl and 2-thiocyanatoethyl ethers; p-chlorobenzyl o-carboxyphenyl sulphide was inactive, but esterification of the carboxyl substituent resulted in considerable activity in the methyl and ethyl esters; the corresponding nitrile had high activity, but the amide was inactive. These variations may be due to lower lipoid solubility of the hydroxy, carboxy and amide compounds than of the corresponding ethers, esters and nitrile. The addition of an o-nitro group in the nucleus of the phenyl moiety completely deactivated p-chlorobenzyl p-chlorophenyl sulphide, but the replacement of a chlorine-substituent in the latter by a nitro-substituent resulted in a compound of little activity in p-chlorobenzyl p-nitrophenyl sulphide, but in one of very high activity in p-nitrobenzyl p-chlorophenyl sulphide. Substitution by the p-cyano group in the benzyl moiety resulted in compounds of high activity when the phenyl moiety was substituted by p-fluorine or p-chlorine, and substitution by p-amino, p-methoxy or 4-methoxy-2-nitro groups in the benzyl moiety in some activity, particularly when the phenyl moiety carried a p-chlorine substituent. Some activity also occurred in p-chlorobenzyl p-tolyl sulphide, but the sulphides of this series generally had considerably less activity than the benzyl phenyl sulphides containing only halogen substituents. Some of the sulphides were oxidised to the corresponding sulphoxides and sulphones, but none of these showed any appreciable activity.

In the second part, it is reported that a series of benzyl phenyl sulphides substituted by groups containing no halogens generally showed little activity; the best resulted when the nucleus of the benzyl moiety was substituted by p-methoxy, p-cyano or p-nitro groups and the nucleus of the phenyl moiety was unsubstituted. The active p-methoxybenzyl phenyl sulphide was deactivated by the introduction of a p-methoxy group into the phenyl moiety, but retained activity after the addition of a p-methyl group there. The introduction of a p-methyl group in the phenyl moiety completely deactivated the active p-nitrobenzyl phenyl sulphide. Sulphones, obtained by oxidising the corresponding sulphides with hydrogen peroxide, showed no appreciable activity.

The third part deals with a corresponding series of sulphides in which one of the benzene nuclei was replaced by a heterocyclic nucleus; some of them proved very effective. Of these, benzyl benzoxazol-2-yl sulphide was little affected by the substitution of fluorine in the para position of the benzyl moiety, but was improved by the substitution of chlorine and reduced in activity by the substitution of bromine or a nitro group in this position. In benzyl benzthiazol-2-yl sulphide, the very high activity was diminished by the substitution of p-chlorine and still further diminished by the substitution of a p-nitro group in the benzyl moiety; there was little difference in activity between benzyl 5-chlorobenzthiazol-2-yl sulphide and p-chlorobenzyl 5-chlorobenzthiazol-2-yl sulphide, but the corresponding p-nitrobenzyl derivative was almost completely inactive. Very good results were also given by p-chlorobenzyl pyrid-2-yl sulphide, but the unsubstituted compound and the corresponding p-nitrobenzyl derivative had no appreciable activity, whereas benzyl pyrid-4-yl sulphide and the corresponding p-chlorobenzyl and 2,4-dichlorobenzyl derivatives, though not the p-nitrobenzyl derivative, showed considerable toxicity; the activity of the chlorobenzyl derivatives decreased progressively as the chlorine substituent occupied the para, meta and ortho

positions. Benzyl 4,6-dimethylpyrimid-2-yl sulphide and its p-chlorobenzyl derivative had similar, fairly high activity, but the p-nitrobenzyl compound was inactive. The unsubstituted compound was more active than the p-chlorobenzyl derivative in benzyl 4-phenylthiazol-2-yl sulphide but less so in benzyl 4-methylthiazol-2-yl sulphide, and the derivatives showed similar moderate activity in benzyl quinol-2-yl and benzyl thiazolin-2-yl sulphide but were virtually inactive in the case of benzyl benziminazol-2-yl, benzyl 4-methylglyoxalin-2-yl and benzyl 4-phenylglyoxalin-2-yl sulphide. A few sulphides were oxidised to the sulphones, but only p-chlorobenzyl pyrid-2-yl sulphone showed any activity. Of the heterocyclic-methyl phenyl sulphides, only benzoxazol-2-ylmethyl p-chlorophenyl sulphide was appreciably active.

The compounds dealt with in the last part, bearing substituents in the α-position of the benzyl moiety, can be regarded as benzyl phenyl sulphides containing, in addition to any nuclear substituents, one in the methylene group of the bridge between the two benzene nuclei. Although all the nuclear substituents were halogens, none of the compounds had any noteworthy activity, an unsubstituted methylene group in the bridge being apparently necessary for high toxicity.

Walz (A. J.). **Observations on the Biologies of some Hymenopterous Parasites of the Cabbage Seedpod Weevil in northern Idaho.**—*Ann. ent. Soc. Amer.* **50** no. 3 pp. 219–220, 2 refs. Washington, D.C., 1957.

Ceutorhynchus assimilis (Payk.) infests the pods of turnip and rape in Idaho, reducing the yield of seed. The larvae were observed to be parasitised in 1948, and rape pods were therefore collected in 1949 and taken to the laboratory for investigations. Five species of parasites were obtained [*cf. R.A.E.*, A **38** 22], of which *Trichomalus fasciatus* (Thoms.), *Xenocrepis pura* Mayr and *Necremnus duplicatus* Gah. were the most abundant. The combined larval and pupal stages of these three species lasted up to 20, 19 and 17 days, respectively, the pupal stage lasted 5–11, 4–6 and 4–6 days for males and 3–13, 5–8 and 3–6 days for females, and the ratio of males to females was 1:2·2, 1:1·21 and 1:3·25. The other two parasites, which were rare, were *Habrocytus* sp. and *Trimeromicrus maculatus* Gah. All were ectoparasitic.

Beck (S. D.). **The European Corn Borer, *Pyrausta nubilalis* (Hübn.), and its principal Host Plant. IV. Larval Saccharotrophism and Host Plant Resistance.**—*Ann. ent. Soc. Amer.* **50** no. 3 pp. 247–250, 2 graphs, 23 refs. Washington, D.C., 1957.

The following is virtually the author's summary of this part of a series [*cf. R.A.E.*, A **46** 311, etc.]. Investigation of the influence of the sugar concentration of the food-plant on the growth of newly hatched larvae of *Pyrausta nubilalis* (Hb.) disclosed that larval growth was positively correlated with sugar content of the plant tissues only when on maize plants of identical size and variety. The correlation tended to break down when plants of different sizes were considered. Although larval growth was different on different maize varieties, no consistent varietal differences in tissue sugar content were observed. When concentrates of Resistance Factors A and B [*cf. loc. cit.*] were added to purified diets, it was found that the biological activity of Factor A was inversely proportional to the sugar (glucose) content of the diet. The activity of Factor B was not affected by dietary sugar

within the range of concentrations tested. It is postulated that the major biological function of saccharotrophism in the borer is its survival value in the face of the Resistance Factor A produced by the plant.

Atkins jr. (E. L.), Frost jr. (M. H.), Anderson (L. D.) & Deal (A. S.). **The "Omnivorous Leaf Roller", *Platynota stultana* Wlshm., on Cotton in California: Nomenclature, Life History, and Bionomics (Lepidoptera, Tortricidae).**—*Ann. ent. Soc. Amer.* **50** no. 3 pp. 251–259, 1 fig., 16 refs. Washington, D.C., 1957.

Platynota stultana Wlsm., all stages of which are described, caused widespread damage to cotton [*cf.* *R.A.E.*, A **46** 95] and lucerne in Imperial County, California, in 1954. The synonymy [*cf.* **22** 108], common names and numerous food-plants of this Tortricid are reviewed, and a detailed account is given of observations on its bionomics carried out on cotton in the laboratory at 70, 80 and 90°F. and 70 per cent. relative humidity. The techniques adopted are described. The eggs were laid in masses on the upper surfaces of the newer leaves and occasionally on the lower leaf surfaces or on the stems or bolls, after a preoviposition period of three days, and the larvae crawled to the tops of the plants and fed on the leaf or flower buds and later on the leaves, which they rolled and fastened together with silk. Pupation occurred in the rolled leaves. The egg, larval and pupal stages averaged 9·1, 30·8 and 8·9 days, respectively, at 70°F., 6·9, 24·9 and 6·4 days at 80°F., and 5·3, 20 and 4·4 days at 90°F., and fertilised females laid an average of 306 eggs each when honey solution and water were provided, and 127 when they were not. The larvae were parasitised on cotton in the field by *Goniozus platynotae* Ashm. (which was itself parasitised by *Catolaccus aeneoviridis* (Gir.)), *Cremastus platynotae* Cushm. and *Apanteles* sp., and destroyed by *Orius tristicolor* (White) and several other predacious insects, but the control afforded did not exceed 10 per cent. and was often much less.

Sekhar (P. S.). **Mating, Oviposition, and Discrimination of Hosts by *Aphidius testaceipes* (Cresson) and *Praon aguti* Smith, primary Parasites of Aphids.**—*Ann. ent. Soc. Amer.* **50** no. 4 pp. 370–375, 13 refs. Washington, D.C., 1957.

In tests in Massachusetts, *Aphidius testaceipes* (Cress.) was reared on *Aphis gossypii* Glov. and *Myzus persicae* (Sulz.), and *Praon aguti* Smith on *Macrosiphum rosae* (L.), in the laboratory. Isolated pairs of the two Braconids did not mate until 80 and 90 minutes after emergence, and all had mated within four days and 30 hours, respectively. Males paired frequently, but females only once; mated females produced offspring of both sexes, but unmated females only males. Mated females of *Aphidius* and *Praon* began to oviposit 4–85 and 2–70 minutes after pairing, and unmated ones about 150 and 120 minutes after emergence; when hosts were available for one hour per day, oviposition reached a maximum on the third and third–fifth days, respectively. Half-grown Aphids were preferred, and already parasitised ones usually avoided. Most eggs were laid in the abdomen, and the greatest numbers of offspring produced by single females were 254 for *Aphidius* and 230 for *Praon*. Mated females produced more females than males, particularly at the beginning of the oviposition period, but the number of female progeny decreased more rapidly than that of males as the oviposition period advanced. Both parasites discriminated between cast skins and living hosts, the ability to do so increasing rapidly with experience.

Kring (J. B.). **Oviposition Response of *Limonius agonus* (Say) (Coleoptera, Elateridae) to Sand Particle Size.**—*Ann. ent. Soc. Amer.* **50** no. 4 pp. 392–394, 1 fig., 6 refs. Washington, D.C., 1957.

In the United States, *Limonius agonus* (Say) is normally found in large numbers in fine sandy soils that are cropped continuously, whereas *Agriotes mancus* (Say) is numerous only in heavier sod soils, and although dense populations of the two wireworms may occur within a few miles of each other, no instances of mixed populations have been recorded. Field and laboratory tests have shown that the restriction of *L. agonus* to sandy soils is due to the selection of these for oviposition, but no differences in temperature, available moisture, growing crops, crop residues or colour were found to influence the choice. When gravid females were caged on sands of different particle sizes, however, they always chose the finer ones for oviposition, responding to maximum physical contact with the sand, and to a less extent choosing those more easily manipulated with the mandibles. *A. mancus*, which enters the soil through cracks, showed no similar reaction.

Langston (R. L.). **A Synopsis of Hymenopterous Parasites of *Malacosoma* in California (Lepidoptera, Lasiocampidae).**—*Univ. Calif. Publ. Ent.* **14** no. 1 pp. [3 +] 1–49, 45 refs. Berkeley, Cal., 1957.

Several species of *Malacosoma* are of importance as pests of fruit trees or other plants in California, and as little was known of the natural enemies of species of this genus in that part of the United States, eggs, larvae and pupae were collected there in 1954 and 1955 and Hymenopterous parasites reared from them. In this report of the results, the author gives notes on the procedures employed, the bionomics of *Malacosoma* spp. as a group, and the distribution, appearance and food-plants of the eight species found, of which one was undescribed and two, *M. pluviale* (Dyar) and *M. disstria* Hb., were separated into races or forms, lists of the parasites recorded from each, showing those so recorded for the first time, a systematic list of the parasites reared during the two years or recorded from the western United States in the literature, showing their distribution, hosts in the genus *Malacosoma* and parasites, followed by notes on morphology, habits and importance, a similar list of the hyperparasites, and another of the parasites of *M. disstria* known in the eastern United States.

In all, 22 species of primary parasites are recorded from the western United States, of which 15 parasitised the larvae or pupae of *Malacosoma* spp. and seven the eggs. Most of them were reared from several host species. The commonest larval parasites were *Rogas* sp. and *Hyposoter fugitivus pacificus* Cushm., which were reared from all the host species, though the percentage parasitism did not exceed 5, except in one locality, in which it reached 15–20 for *Hyposoter*. The most numerous egg parasite was *Tetrastichus malacosomae* Gir., but parasitism by it was low. The commonest of the hyperparasites, which were almost as common as the primary species and themselves sometimes acted as such, was *Dibrachys cavus* (Wlk.), which attacked most of the primary parasites, and of the latter, that most subject to attack was *H. f. pacificus*.

Eaton (C. B.) & Struble (G. R.). **The Douglas-fir Tussock Moth in California (Lepidoptera: Liparidae).**—*Pan-Pacif. Ent.* **33** no. 3 pp. 105–108, 8 refs. San Francisco, Cal., 1957.

A species of *Hemerocampa* that defoliates white fir (*Abies concolor*) in California and was previously thought to be *H. oslari* (Barnes) [*cf. R.A.E.*,

A **26** 581] was found by comparison with type material to be *H. pseudotsugata* McDunn., which is widely distributed on Douglas fir [*Pseudotsuga menziesii*] and true firs [*Abies*] in the north-western United States. The true *H. oslari* is known apparently only from Colorado.

CALLAHAN (P. S.). **Oviposition Response of the Corn Earworm to Differences in Surface Texture.**—*J. Kans. ent. Soc.* **30** no. 2 pp. 59–63, 2 figs., 4 refs. Manhattan, Kans., 1957.

Since females of *Heliothis zea* (Boddie) deposit more of their eggs on the upper, villous surfaces of maize leaves than on the lower, glabrous ones [*cf. R.A.E.*, A **8** 315; **19** 633] and prefer to oviposit on cloth rather than on leaves, wood, wax paper or other surfaces in the laboratory, the responses of the moths to differences of surface texture were investigated in Kansas. The techniques used consisted of placing a newly emerged female on a 1-g. section of leaf or other material and lifting it five times for five seconds by means of a holder, the ability of the moth to maintain its hold being noted, and fixing the moth in an apparatus in which the test surface was pulled away from it by means of a system of pulleys and a variable weight. In all, 17 surfaces, comprising coarse cotton fabrics, balsa wood, and leaves or other plant parts, were tested by the last method and are classified according to the weight supported by the moths. This was greatest for two kinds of villous cloth, lucerne leaves, balsa wood and the villous leaves of a particular variety of maize, less for maize silks and leaf surfaces that were hirsute, strigose or pilose but had fairly distinct ribs or veins, and least for leaf surfaces that were glabrate or punctate and had only slightly defined veins. *Chorizagrotis auxiliaris* (Grote), which is heavier but seemed weaker than *H. zea*, showed similar trends.

ROBERTS (J. E.). **Winter Survival of Southwestern Corn Borer.**—*J. Kans. ent. Soc.* **30** no. 2 pp. 64–65, 1 ref. Manhattan, Kans., 1957.

Mortality of the larvae of *Zeadiatraea grandiosella* (Dyar) overwintering in maize stubble is apparently high in Arkansas, since first-generation eggs are relatively scarce. Survival was found to be only 12 per cent. in the winter of 1954–55 in the north-western part of the State, as compared with 37 per cent. in 1952–53, 30 per cent. in 1953–54 and 41 per cent. in 1955–56. The winter of 1954–55 had very low temperatures, dropping to 3 and 9°F., in February and March, combined with abnormally high rainfall. Experiments during the winter of 1955–56, when temperature and rainfall were more normal, showed that added water in December–February did not increase mortality in field plots or in transplanted stubble, so that the combination of low temperature and high moisture is apparently required.

WOLFENBARGER (D. O.). **Observations of insecticidal Control by Surface Active Agents.**—*Florida Ent.* **40** no. 2 pp. 53–59, 6 refs. Gainesville, Fla., 1957.

Soaps and other surface-active agents have frequently been reported as killing insects, although their mode of action is unknown. In work with various emulsifying agents in Florida, Triton X-160, stated by the

manufacturers to be a mixture of alkyl aryl polyether alcohols and organic sulphonates, proved as safe for plants and as effective as several others, and the results are given of tests begun in 1954 in which it was compared with these and with recognised toxicants against insects and mites. In field tests, sprays of Triton X-160 at 1:100 by volume gave complete control of *Brevicoryne brassicae* (L.) on turnips in two days and was equalled only by a material containing 2 lb. demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] per U.S. gal. diluted to 1 pint per 100 gals. and one containing 4 lb. parathion per U.S. gal. diluted to $\frac{1}{3}$ pint per 100 gals. In a similar test in which counts were made 3, 11 and 18 days after treatment and the results averaged, Triton X-160 gave 86, 82, 77 and 65 per cent. control of *B. brassicae* at dilutions of 1:100, 1:200, 1:400 and 1:800, respectively. Cabbage and turnip plants were injured by Triton X-160 at 1:99. It was ineffective against *Trichoplusia ni* (Hb.) on cabbage or brussels sprouts, whereas insecticide sprays gave good control, but at 1 pint per 100 gals. it gave a good reduction in the number of larvae of *Macalla thyrsisalis* Wlk. feeding on the leaves of mahogany (*Swietenia mahagoni*), on which they produce much webbing, and was as effective as 3 lb. lead arsenate per 100 U.S. gals. Against *Chrysomphalus ficus* Ashm. (*aonidum*, auct.) on the leaves of lime (*Citrus*), the addition of Triton X-160 improved the control given by sprays of parathion, and against *Oligonychus punicae* (Hirst) (*coiti* (McG.)) on the leaves of mango, 0·5 gal. Triton X-160 per 100 gals. gave very good control, was as effective as several acaricides tested and was superior to an oil emulsion and a proprietary dinitro preparation. In a laboratory test, in which avocado leaves infested with *O. yothersi* (McG.) were dipped singly in various liquids, Triton X-160 was as effective as many recognised acaricides and gave complete control after 4 days at 1:800.

Steinhaus (E. A.). **New Records of Insect-virus Diseases.**—*Hilgardia* **26** no. 7 pp. 417–430, 16 figs., 45 refs. Berkeley, Cal., 1957.

Hughes (K. M.). **An annotated List and Bibliography of Insects reported to have Virus Diseases.**—*T. c.* no. 14 pp. 597–629, 255 refs.

The first of these papers is based on records of virus diseases in insects submitted for examination at the University of California since 1950. They included 15 species from the United States or other parts of America having types of virus diseases not previously recorded from them, of which seven were thus shown to be subject to infection by two types of virus. Larvae of *Peridroma saucia* Hb. (*margaritosa* (Haw.)), *Junonia coenia* Hb. and *Sabulodes caberata* Gn., which are known to be susceptible to granulosis viruses, were found to be infected with polyhedra, and those of *Laphygma exigua* (Hb.) and *L. frugiperda* (J.E.Smith), from which polyhedral viruses have been reported, with granulosis viruses; larvae of *Chorizagrotis auxiliaris* (Grote) were found infected with a polyhedrosis in one locality and a granulosis in another, and those of *Nephelodes emmedonia* (Cram.) contained both large numbers of polyhedra and the capsules characteristic of a granulosis infection apparently representing an instance of two viruses infecting a single host at about the same time, though possibly one virus, latent in the host, was activated by infection with the other [*cf. R.A.E.*, A **46** 198]. All these insects were collected in the United States, except *L. frugiperda*, which was from Colombia.

In the second paper, an attempt is made to record all published reports of virus infections pathogenic to insects throughout the world, regardless of their validity. The insects are listed under their families, with an indication

of the type of virus, so far as possible, and references to the bibliography, which includes 255 papers.

Dutch Elm Disease.—*Publ. Dep. Agric. Can.* no. 1010, 11 pp., 8 figs. Ottawa, 1957.

Dutch elm disease, caused by *Ceratostomella ulmi*, was observed on elms in Canada for the first time in 1944, in Quebec [*cf. R.A.E.*, A **36** 163]. It subsequently spread to eastern Ontario, and a further outbreak was found in south-western Ontario in 1950, apparently as a result of spread from the United States. It has not so far been found in the Maritime Provinces or Manitoba. The symptoms of the disease are described. The fungus is disseminated in Canada and the United States by the native *Hylastes* (*Hylurgopinus*) *rufipes* Eichh. and by the introduced *Scolytus multistriatus* (Marsham), which was first observed in Canada in 1948, in south-western Ontario, and is now well established near Toronto. The habits of these Scolytids are described, and sprays of DDT in emulsified solution are recommended to prevent crotch feeding by the adults. This should be supplemented by removal and burning of the bark from all freshly cut elm logs, dying or recently dead trees, broken branches and stumps, or spraying such material with DDT, to prevent breeding. No method of controlling the fungus in the tree is known.

Thomson (M. G.). **Appraisal of Western Hemlock Looper Infestations.**—*For. Chron.* **33** no. 2 pp. 141–147, 1 graph, 3 refs. Toronto, 1957.

Although incipient outbreaks of *Lambdina fiscellaria lugubrosa* (Hulst) in coniferous forests in British Columbia can be detected by adequate ground surveys during the egg or larval stages or by observations of the numbers of moths in autumn in the year preceding heavy defoliation, these populations are not evident to observers unfamiliar with the Geometrid, and outbreaks are sometimes detected only a few weeks before they cause severe damage and tree mortality. Characters distinguishing this species from other Geometrids are indicated, and methods are described for determining the amount of defoliation at the time of detection and estimating the total defoliation likely to occur; this is calculated from the damage observed and the proportion of the population in each instar. Large parasite populations or disease may cause heavy larval mortality and reduce defoliation, but the effects of these factors are difficult to assess until feeding is complete.

The habits of the larvae, which usually eat only a small proportion of each needle, tend to frequent sunlit branches and move rapidly through the crown of the tree, result in rapid and widespread defoliation, and insecticides will protect a stand only if applied before the beginning of the last (fifth) instar; if delayed until the middle of this instar, they will do little to prevent serious defoliation. Where chemical control is impossible, early removal of heavily defoliated trees will reduce losses from secondary beetle attack, rot or breakage and also help to reduce future populations, since most of the eggs are laid in moss or crevices on the bark [*cf. R.A.E.*, A **34** 378].

Banham (F. L.) & Handford (R. H.). **Control of Cutworms in Asparagus Fields in the Interior of British Columbia.**—*Canad. J. Pl. Sci.* **37** no. 2 pp. 108–112, 1 pl., 11 refs. Ottawa, 1957.

The following is based largely on the authors' summary. Emulsion concentrates containing 18·5 per cent. dieldrin, 18·5 per cent. isodrin, 20 per

cent. aldrin, 60 per cent. toxaphene or 65·5 per cent. chlordane incorporated in the soil to a depth of about 4 ins. at rates of 1·5, 0·5, 4, 10 and 10 lb. toxicant per acre, respectively, proved highly effective against larvae of *Euxoa ochrogaster* (Gn.) in asparagus fields in the interior of British Columbia in the summers of 1953 and 1954. In 1953, the aldrin concentrate was much more effective when mixed with the soil than when applied to its surface only. Bran bait containing paris green was fairly satisfactory but was less effective and slower in action. In 1952, dusts of 2 per cent. dieldrin, 2·5 per cent. aldrin or 2 per cent. isodrin applied to the surface at 2·5, 3 and 0·2 lb. toxicant per acre, respectively, were superior to and more rapid in action than bran baits containing endrin and aldrin at rates of 1 and 2 oz. toxicant per acre, respectively, and all treatments were slower in action in dry than in moist soil. A survey of asparagus fields treated by growers in 1953 but not in 1954 indicated that the aldrin concentrate, mixed with the soil at about 4 lb. toxicant per acre, protects asparagus from the cutworm for at least two years.

Slykhuis (J. T.), Andrews (J. E.) & Pittman (U. J.). **Relation of Date of Seeding Winter Wheat in southern Alberta to Losses from Wheat Streak Mosaic, Root Rot, and Rust.**—*Canad. J. Pl. Sci.* **37** no. 2 pp. 113–127, 6 figs., 9 refs. Ottawa, 1957.

The following is almost entirely the authors' summary. Immature wheat is the most important reservoir of the streak mosaic virus and its mite vector, *Aceria tulipae* (Keifer), in southern Alberta [*cf. R.A.E.*, A **45** 476]. Experiments on sowing dates there in 1953–55 showed that losses from the disease were greatest in winter wheat sown before neighbouring crops of winter or spring wheat that harboured the virus were mature. Wheat that emerged after the diseased crops had matured was seldom infected. Infection was spread from diseased self-sown wheat as long as it was living, or until the weather became cold in late October or November. Wheat sown in August was more severely damaged than that sown later. Immature wheat harbouring mosaic infection was completely destroyed by one operation with a mouldboard plough, but not by one cultivation with the one-way disk or subsurface type of cultivator. Development of root rot was most, and that of stem rust least, severe in wheat sown in August. In the absence of disease, yields decreased in wheat sown after mid-September. It is concluded that winter wheat is best sown in early September.

George (J. A.) & Richardson (J. K.). **Aster Yellows on Celery in Ontario.**—*Canad. J. Pl. Sci.* **37** no. 2 pp. 132–135, 1 pl., 13 refs. Ottawa, 1957.

The following is based almost entirely on the authors' summary. A disease of celery reported by growers in the Niagara Peninsula, Ontario, in 1953 was shown in controlled transmission tests with *Macrosteles fascifrons* (Stål) and *Fieberiella florii* (Stål) to be caused by the aster yellows virus, the strain involved being similar to that occurring in California. Since *M. fascifrons* occurs on a wide range of plants throughout Ontario and is usually present on celery in large numbers throughout the season, whereas *F. florii* is common only on privet [*Ligustrum*], it is probably the more important vector. Celery is also attacked by the disease in New Brunswick, where it was first recorded in 1949.

Finlayson (D. G.). **Further Experiments on Control of the Onion Maggot, *Hylemya antiqua* (Mg.), in the Interior of British Columbia.**—*Canad. J. Pl. Sci.* **37** no. 3 pp. 252–258, 1 pl., 11 refs. Ottawa, 1957.

DDT provides an effective and inexpensive substitute for mercurous chloride (calomel) in seed dressings against *Hylemyia antiqua* (Mg.) on onion in the interior of British Columbia [*cf. R.A.E.*, A **44** 33], but the amount required for satisfactory control was found in practice to cause an irregular flow of seed. Since aldrin and dieldrin gave practical control at lower rates [**44** 34], they were compared with lindane [γ BHC], DDT and mercurous chloride in 1952–53, and the following is based on the author's summary of the results. Dieldrin at 0·5 oz. per lb. seed gave as good control as any other treatment, was not phytotoxic, and resulted in the highest yield of marketable onions each year. Mercurous chloride at 1 lb. per lb. seed was satisfactory against a light infestation, but cost 20 times as much as dieldrin. DDT at 8 oz. per lb. seed gave effective control, but the bulk of insecticide on the seed caused jamming of the seeder. When the amount of DDT was reduced, plant damage increased. Aldrin and γ BHC at 1 oz. per lb. seed were phytotoxic, the latter extremely so. Three applications of 25 per cent. wettable γ BHC to the soil at 1 lb. toxicant in 260 gals. water per acre gave consistently good control, but this treatment was expensive in both labour and materials.

Miller (L. A.), Miles (J. R. W.) & Sans (W. W.). **DDT and DDD Residues on Tomatoes processed into Juice.**—*Canad. J. Pl. Sci.* **37** no. 3 pp. 288–291, 3 refs. Ottawa, 1957.

The following is based on the authors' summary. In 1954 and 1955, tomatos that had been sprayed with DDT or DDD against *Heliothis zea* (Boddie) in south-western Ontario [*cf. R.A.E.*, A **46** 266] were processed into juice, and the components analysed for residues of these compounds. Four applications of DDT at 1·25 or 2·5 lb. per acre and four of DDD at 1·5 lb. per acre were made in 1954, and six of each material at 1·5 and 3 lb. per acre in 1955. Approximately 80 per cent. of the residue was removed during washing, and most of the remainder was concentrated in the waste. Residues in the juice did not exceed 0·13 part per million.

Roberts (D. W. A.). **Sawfly Resistance in Wheat. II. Differences between Wheat grown in the Greenhouse and on irrigated Land.**—*Canad. J. Pl. Sci.* **37** no. 3 pp. 292–299, 3 refs. Ottawa, 1957.

In this second part of a series on resistance to attack by *Cephus cinctus* Nort. in wheat in Canada [*cf. R.A.E.*, A **44** 272], the author describes investigations carried out to discover whether the results of experiments in the greenhouse or on irrigated plots are applicable to dry-land field conditions. In the seven varieties of wheat tested, the percentage of infested stems cut by *C. cinctus* was higher in plants grown in the greenhouse in summer or winter than in plants grown under irrigation in the field, and the differences were significant in five. This lower resistance of plants grown in the greenhouse was associated with a decrease in the percentage of tunnelled stems in which older larvae had died. In percentage of infested stems cut, no significant differences were found between the varieties grown in irrigated plots and in outdoor soil-bins on adjoining land. In other two-year tests on irrigated land, the variable resistance of wheat was apparently associated

with variations in the percentage of tunnelled stems in which older larvae had died. Although stem solidness is usually associated with resistance on dry land, it appears that this characteristic alone cannot be relied on as a measure of resistance in a given variety when grown in diverse environments.

Lyons (L. A.). **Insects affecting Seed Production in Red Pine. III.** *Eucosma monitorana* **Heinrich,** *Laspeyresia toreuta* **Grote (Lepidoptera: Olethreutidae),** *Rubsaamenia* **sp. (Diptera: Cecidomyiidae), and other Insects.**—*Canad. Ent.* **89** no. 4 pp. 150–164, 7 figs., 15 refs. Ottawa, 1957.

In this further part of a series on the insects that reduce seed production in red pine [*Pinus resinosa*] in Ontario [*cf. R.A.E.*, A **46** 315, etc.], accounts are given of observations on the bionomics of *Eucosma monitorana* Heinr., *Cydia* (*Laspeyresia*) *toreuta* (Grote) and an undescribed species of *Rübsaamenia*, with descriptions of all stages of the first two and of the larva of the last and notes on some 12 other insects found on or in the cones.

During 1950–54, *E. monitorana*, *C. toreuta* and *Rübsaamenia* contributed significantly to seed loss, but that caused by *E. monitorana* rarely exceeded 40 per cent. and that due to the other two species was usually light, though in the case of *Rübsaamenia* it occasionally exceeded 40 per cent. All three attack second-year cones. Adults of *E. monitorana*, which was very local, emerged in May, and the damage began in early June, when the first-instar larvae entered the upper part of the cone and tunnelled towards the axis, where they fed on the immature ovules, more than 25 sometimes occurring in one cone. When all the ovules and scales had been consumed, the larvae, which had by then reached the fourth instar, migrated to other cones. The fully grown larvae left the cones in July, but pupae were not found in the field. *Ephialtes* (*Calliephialtes*) *comstockii* Cress. and *Apanteles* sp., near *A. tischeriae* Vier., were reared from the larvae, and larvae of *Attalus nigrellus* (Lec.) caused slight mortality by preying on larvae in the cones.

C. toreuta attacks the seeds of jack pine [*Pinus banksiana*] in Ontario as well as those of *P. resinosa*. The adults emerged during the second half of June, and eggs were laid in crevices in sound cones. The larvae entered the upper parts in early July and mined within the inner face of the scales to the seeds, in which they fed on the embryos. On reaching the fourth instar, they left the original seeds and subsequently consumed 3–9 more. In late August or early September, they overwintered in short tunnels in the axis of the cone. Pupation took place in May of the following year or of the one after, and the proportion of larvae in which it was delayed was very variable. Parasitism by *E. comstockii* and a species of *Phanerotoma* near *P. laspeyresiae* Rohw., both of which attacked the full-fed larvae, was the chief cause of mortality in the cone, and *Phanerotoma* was responsible for 38 per cent. mortality at one place in 1951 and 26 per cent. in another in 1952. Infested cones are not easily recognised, but larvae in them did not survive the process of seed extraction, which involves exposure to 160–170°F. at 10–20 per cent. relative humidity for 2½ hours.

Rübsaamenia attacked both sound and damaged second-year cones in June. As many as 100 young larvae of this Cecidomyiid were found in one cone, but rarely more than 25 became mature. Infestation causes slight withering and shrinking of scale tips and, if heavy, causes the scales to separate prematurely. Feeding was superficial on the seeds and scales.

Most of the full-fed larvae left the cones in early summer, but a few overwintered in puparia in the cones. Adults emerged in early summer. *Tetrastichus* sp. near *T. hunteri* Crwf. was reared from the puparia in spring or early summer.

Of the other insects dealt with, *Rhyacionia buoliana* (Schiff.) is the only one that attacks undamaged cones.

Silver (G. T.). **Studies on the Arborvitae Leaf Miners in New Brunswick (Lepidoptera: Yponomeutidae and Gelechiidae).**—*Canad. Ent.* **89** no. 4 pp. 171–182, 1 fig., 8 refs. Ottawa, 1957.

The following is based largely on the author's summary of this second paper of a series [*cf. R.A.E.*, A **46** 332], in which he records studies on the bionomics of *Argyresthia thuiella* (Pack.), *A. freyella* Wlsm., *A. aureoargentella* Brower and *Recurvaria thujaëlla* Kearfott on arbor-vitae (*Thuja occidentalis*) in New Brunswick, carried out between 1950, when the outbreak that began about 1947 was at a maximum, and 1953, when it had declined. *T. occidentalis* is the principal food-plant of all these leaf-miners, and they are found generally throughout its range.

Adults of *A. thuiella* emerge between mid-June and mid-July, and the females lay up to 25 eggs each on the new foliage. The larvae hatch in 11–20 days and start mining immediately. The winter is passed as a fifth-instar larva. Feeding is resumed in early May, and the larvae pupate in the mines in late May and June, the entire larval life being spent in one mine. The pupal stage lasts 16–25 days. The life-histories of *A. freyella* and *A. aureoargentella* are similar in respect to dates, but the larvae each make two or more mines during their development and pupate in cocoons spun on the surface of the leaves. Adults of *R. thujaëlla* emerge up to two weeks later than those of *A. thuiella*, and the larvae overwinter in the second or third instar. The entire larval life is usually spent in one mine, in which pupation occurs. *A. thuiella* and *R. thujaëlla* kill less foliage as a result of mining than they do by feeding, but the other two species cause considerably more indirect than direct damage, since the larvae frequently make short mines that kill several shoots. Heavy combined populations of the four species caused up to 80 per cent. defoliation of trees in observation plots, but few trees died.

In 1950 and 1951, over 60 per cent. of the larvae of *Argyresthia* spp. were killed by parasites; parasitism among larvae of *R. thujaëlla* was only 2 per cent. in 1953, but reached 22 per cent. in 1954. In all, 27 species of Hymenoptera, a list of which is given, were reared from the four species, but no predators or diseases were observed. In an experiment on control in 1950, the best results were given by a spray of 5 lb. lead arsenate or DDT and 1 pint linseed oil per 100 gals. water.

Drooz (A. T.). **Spray Chamber Insecticide Tests on the Larch Sawfly (*Pristiphora erichsonii* (Htg.)).**—*Canad. Ent.* **89** no. 4 pp. 183–187, 2 figs., 7 refs. Ottawa, 1957.

The tests described were carried out in Minnesota in 1956 in connection with the possibility of controlling *Pristiphora erichsonii* (Htg.) on larch by insecticides applied from the air. Larvae in various instars were sprayed in a chamber with known concentrations of DDT, γ BHC or malathion in oil at a standard rate of application, and the results are shown in a table. DDT proved quite ineffective against larvae in the fourth and early fifth

instars, even at 0·025 lb. in 1 U.S. gal. spray per acre, but γ BHC and malathion were effective, the LD50 and LD90 being 0·00115 and 0·01237 lb. in 1 U.S. gal. per acre for the former and 0·00477 and 0·01702 lb. for the latter.

WATTERS (F. L.) & COX (G. A.). **A Water-trap for detecting Insects in stored Grain.**—*Canad. Ent.* **89** no. 4 pp. 188–192, 2 graphs, 8 refs. Ottawa, 1957.

Much loss of stored grain in Manitoba is caused by insect populations too small to be detected by the sampling methods used, and as it was observed that adults of *Cryptolestes* (*Laemophloeus*) *ferrugineus* (Steph.) were frequently trapped in the jars of water used to increase the relative humidity above laboratory cultures of this Cucujid, the value of water-traps for detecting low populations was investigated in granaries and in the laboratory. The traps consisted of 6-oz. glass jars filled with water to within an inch of the top and sunk in the grain so that their tops were level with the surface. When traps distributed evenly in grain stored in four granaries, each with a capacity of 1,000 bushels, and thought to be uninfested, and in infested grain stored in an annexe with a capacity of 25,000 bushels were examined after about ten days, adults of *Enicmus* spp. and *Ptinus villiger* (Rttr.) and larvae of *Tenebrio molitor* L. and *Dermestes lardarius* L. were found in those in the former and most of the insects that commonly infest stored grain in Manitoba in the latter. Psocids and mites were relatively scarce or absent, but were the only arthropods found in samples of grain taken from the surface and at a depth of 3 ft. in the granaries and the chief ones in samples from the surface and at depths of 4 and 8 ft. in the annexe. In a laboratory experiment, jars, of which alternate ones were filled with water, were sunk in wheat that had a moisture content of 12, 15 or 18 per cent. and was artificially infested with adults of *C. ferrugineus*, *Calandra* (*Sitophilus*) *granaria* (L.) and *Tribolium confusum* Duv. Significantly more adults of *C. granaria* were trapped in water than in the empty jars when the wheat contained 12 or 15 per cent. moisture, but there was no significant difference in numbers when the moisture content was 18 per cent. *Cryptolestes* was always significantly more numerous in the water-traps than in the empty jars, and significantly greater numbers of both species were trapped when the moisture content of the wheat was 12 or 15 than when it was 18 per cent. *T. confusum* was more abundant in empty jars than in those containing water, which trapped very few. In a further test, insects covered with grain to depths of 14, 28 or 60 ins. entered traps at the surface less frequently than those covered to a depth of 5 ins.

MILNE (A.). **The natural Control of Insect Populations.**—*Canad. Ent.* **89** no. 5 pp. 193–213, 2 figs., 37 refs. Ottawa, 1957.

The following is based on the author's summary of this paper, in which he defines the problem of the natural control of insect populations, describes and examines the prevailing theory, which is that of A. J. Nicholson (1933) [*R.A.E.*, A **21** 369], and is similar to that of H. S. Smith (1935) [**24** 159], and the most useful opposing theories, which are those of W. R. Thompson (1929) [**18** 80] and Andrewartha & Birch (1954) and resemble each other, and finally states his own theory. The main objection to Nicholson's theory is that competing species, parasites, predators and pathogens cannot control

because they are imperfectly density dependent in action. This is at once obvious from simple mathematical and ecological considerations and is confirmed by the field evidence. The main objection to the theories of Thompson and of Andrewartha & Birch is that the former pays too little attention and the latter attach no special importance to the concept of density dependence, so that both are deprived of fullness. The author's theory, which is based largely on that of Thompson, but includes elements derived from the others and from field experience, is as follows. A perfectly density dependent factor or process will control increase of numbers endlessly. There is only one such in nature for any species, and that is competion between its own individuals. This is the ultimate controlling factor for increase. In nature, however, most species, in most places for most of the time, are held fluctuating at population levels where this kind of competition is relatively insignificant; that is, the ultimate controlling factor for increase is seldom evoked. The suggestion therefore must be that control of increase is, for most of the time if not almost endlessly, a matter of the combined action of factors that are density independent and factors that are imperfectly density dependent, each supplying the lack of the other. The ultimate control of decrease of numbers is brought about by density independent factors.

Smith (J. M.). **Effects of the Food Plant of California Red Scale, *Aonidiella aurantii* (Mask.) on Reproduction of its Hymenopterous Parasites.**—*Canad. Ent.* **89** no. 5 pp. 219–230, 50 refs. Ottawa, 1957.

In view of reported differences in the control of insects given by parasites when their host occurs on different food-plants [*cf. R.A.E.*, A **31** 328, 331], the effect of seven plant species on *Aonidiella aurantii* (Mask.) and on the development of its parasites was investigated in greenhouse experiments in California in 1948–49, and the following is based partly on the author's summary of the results. The largest Coccids and parasites developed on stems of castor (*Ricinus communis*), but this plant was omitted from the main experiments owing to thrips injury. On the other six plants, development of *A. aurantii* was most rapid on *Yucca filipendula* and slowest on orange, and the largest and smallest Coccids, respectively, were produced on these two plants. Development was more rapid and the Coccids larger on agave (*Agave decipiens*) and lemon than on sago palm (*Cycas revoluta*) or grapefruit. The food-plant of the host affected the reproduction of its parasites both directly and indirectly. Oviposition by *Comperiella bifasciata* How. was retarded when the host was reared on sago palm. The scales of Coccids reared on potato tubers [*cf.* **37** 256] became overlaid by potato cuticle during their formation, which provided a partial mechanical barrier to oviposition by *Aphytis chrysomphali* (Merc.) and *A. lingnanensis* Comp. Adults of *C. bifasciata* and *Habrolepis rouxi* Comp. reared in Coccids on *Yucca* were larger, longer lived and more prolific, and included a higher proportion of females than those reared in Coccids on the other plants. Mortality among the immature stages of these parasites was highest in Coccids reared on fronds of sago palm, in which *H. rouxi* was unable to survive. Experiments with *H. rouxi* to demonstrate an effect of the food-plant of the host on the sex ratio of a bisexual uniparental parasite gave inconclusive results, but tended to confirm an earlier finding that there may be one under certain temperature conditions. *Yucca* proved the most satisfactory plant on which to rear *A. aurantii* and its parasites, and it is suggested that it might be used to provide a valuable source of parasites of *A. aurantii* on *Citrus* in the field.

Vasseur (R.) & Schvester (D.). **Biologie et écologie du pou de San José (*Quadraspidiotus perniciosus* Comst.) en France.**—*Ann. Épiphyt.* **8** no. 1 pp. 5–66, 9 figs., 62 refs. Paris, 1957.

The distribution of *Quadraspidiotus perniciosus* (Comst.) in France, where this Coccid was observed in 1935 in the extreme south-east, in 1941 near Lyons [*cf. R.A.E.*, A **33** 125, 356], subsequently in the central area and in 1952 in Alsace, is discussed [*cf.* **44** 433] and illustrated on a map, and a detailed account is given of observations on its bionomics, carried out principally since the war in the district of Lyons. In that area, it has two main generations a year and overwinters in the first nymphal instar. Observations on apple in 1946–54 showed that the first moult occurred on 10th–26th March and that adult females appeared between 13th April and 2nd May, the winged males emerging at about the same time. First-generation crawlers appeared between 22nd May and 13th June and gave rise to adults between 30th June and 26th July, though some entered diapause when weather conditions were poor. Second-generation crawlers appeared between 25th July and 12th August, and most of these went into diapause and overwintered, though some completed their development in late September or October and gave rise to a third generation of crawlers under favourable conditions; these rarely developed sufficiently to overwinter. There is considerable overlapping of stages. In the Mediterranean region, where development is resumed about a month earlier in spring, three or four generations may occur.

Tests in which pear twigs were infested with second-generation crawlers and kept at various temperatures from mid-August to mid-December 1950 indicated that the threshold of development lay at about 9–10°C. [48·2–50°F.]. At 13–14°C. [55·4–57·2°F.], a few individuals reached the first moult, in 60–65 days, and at 16–17°C. [60·8–62·6°F.], a few more did so, in 35–38 days; the remainder entered diapause. At 20–21°C. [68–69·8°F.], the first moult was reached in 20 days, adults appeared in 35–37 days, and first crawlers appeared after about 60 days. Nevertheless, 40 per cent. of the original population was still in the first stage at the end of the experiment. At 25–26°C. [77–78·8°F.], the corresponding periods were 15–16, 20–23 and 42 days, and very few of the original population entered diapause. At 31–32°C. [87·8–89·6°F.], the first moult was reached in 10 days and adults appeared in 19–21 days, but mortality reached 50 per cent., and at 38–40°C. [100·4–104°F.], development was abnormal and all the crawlers died in 10–12 days. When apple twigs were infested with first-generation crawlers between 24th May and 13th August 1948, the percentages entering diapause were very variable but were higher on plants placed in the shade than on those in the sun, and were increased by low temperatures during the first 10–20 days of development. It is concluded that the onset of diapause is due to low temperature, but that light possibly has some effect.

The production of crawlers continues under favourable conditions until November or even December, but observations in which sections of twig were infested with crawlers on various dates during the autumn and examined in the following April showed that few of those that appeared after about mid-October survived the winter. In a further test, branches infested with overwintering nymphs were removed to the laboratory between 6th December and 24th February and kept at 15 or 20°C. [59 or 68°F.]. Moulting began after 21 days at 15°C. and after 7 days at 20°C. and was completed in 28 and 16 days, respectively, for those taken on the earliest date, but the intervals decreased to 7 and 3 days and the periods for completion of the moult to 13 and 5 days, respectively, for those taken on the last. Similar findings were obtained during the following winter, and it is concluded that post-diapause development proceeds to the stage immediately

preceding moulting and is then suspended until the temperature reaches a suitable level [*cf.* **41** 388].

Various tests in which *Q. perniciosus* was reared in the laboratory on apple at 18–21°C. [64·4–69·8°F.], and the immature males removed showed that the females do not reproduce parthenogenetically. Mortality was generally only 15–20 per cent. among overwintering nymphs at Lyons, but was sometimes 40 per cent. or more during the first moult. In the Mediterranean region, winter mortality was higher, since the overwintering population was more heterogeneous, and the totals for all overwintering stages during the winter of 1949–50 were 51·2 and 44·8 per cent. in two localities on pear and 73·5 on apple in a third. Heavier winter mortality occurs among overwintering nymphs of the first generation than among those of the second. Summer mortality was variable, and the Coccid was able to withstand periods of cool, wet weather fairly well, though hot, dry periods caused high mortality, particularly of the younger stages. In May 1951, which was cool and humid, mortality was nearly 30 per cent. near Lyons, and during June–September, when temperatures were normal, it reached 22·5 per cent., but in June–September of the following year, when the weather was hot and dry, it was as high as 66·5 per cent. Nevertheless, the reduced fecundity, delayed development and increased occurrence of first-generation diapause that occur in cool weather render a warm, dry summer more favourable for heavy infestation.

Investigations on natural enemies of the Coccid showed that the parasites present are not very effective [*cf.* **44** 105, etc.]. The predators observed comprised *Cybocephalus* sp. and three Coccinellids, *Exochomus quadripustulatus* (L.), *E. flavipes* (Thnb.) and *Chilocorus bipustulatus* (L.). The last was the most widespread and abundant and constituted 80 per cent. of the total predator population. It has two generations a year and devours the adults and particularly the younger stages voraciously, completely destroying the population on individual plants. The Coccinellids were unevenly distributed, however, and up to 80 per cent. of the larvae were parasitised by *Homalotylus flaminius* (Dalm.) and *Tetrastichus epilachnae* (Giard), of which the last was the more injurious.

The wide food-plant range of *Q. perniciosus* is discussed from observations in France [*cf.* **33** 5], and tables are given showing the various plants (grouped in 34 families) on which the Coccid was able to complete its life-cycle and those on which it was not, together with a list of plants other than fruit trees, which are its main economic hosts, on which infestation was observed near Lyons. Differences in the suitability of the various plants are reviewed at some length, and it is concluded that *Q. perniciosus* has sufficient biological plasticity to adapt itself to unaccustomed food-plants.

Vasseur (R.) & Schvester (D.). **Observations sur les traitements en cours de végétation contre le pou de San José** (*Quadraspidiotus perniciosus* **Comst.**).—*Ann. Epiphyt.* **8** no. 1 pp. 101–110, 1 fig., 9 refs. Paris, 1957.

Although winter sprays afford the most effective control of *Quadraspidiotus perniciosus* (Comst.) on fruit trees in France, summer treatment is required if infestation is heavy or discovered too late for winter spraying. Summer oil emulsions are insufficiently effective when used alone at non-phytotoxic concentrations, and tests were therefore carried out in various localities in south-eastern France in 1948–51, in which synthetic insecticides were added to them or used in other ways for control of the Coccid on apple and pear.

In 1948, some of the trees were sprayed on 8th–9th June, and the total mortality percentages on 6th July were 40·7 for 0·8 per cent. summer oil emulsion, 47·4 and 44·3 for this with 0·01 per cent. wettable parathion and 0·1 per cent. wettable BHC, respectively, and 93·5 and 91·6 for 0·8 and 0·56 per cent. oil emulsion with 0·1 per cent. wettable DDT. Other trees were sprayed on 8th September, and the mortality percentages on 7th October, calculated according to Abbott's formula [*R.A.E.*, A **13** 331] were 8·7 for 0·1 per cent. wettable DDT, 53·3 for 0·83 per cent. oil emulsion and 81·3 for the two together. The high mortality obtained with the mixed sprays occurred more in the crawler than in older stages, and most of the crawlers produced during the period following spraying were apparently killed by them before leaving the parent females, which themselves survived in some cases. The function of the oil in such mixtures is apparently to facilitate the penetration of the DDT beneath the scale. In 1949, apple and pear trees treated on 1st September were artificially infested on 13th–15th or 28th–30th September, and the numbers of living and (in brackets) dead individuals in samples taken 15 days after each of the two infestations were, respectively, 155 (57) and 120 (190) for 0·1 per cent. wettable DDT, 25 (139) and 75 (239) for this with 0·8 per cent. oil emulsion and 198 (15) and 548 (66) for no treatment. In 1950, apple trees were sprayed on 25th July, and the percentage mortality was estimated by Abbott's formula for insects of various age groups. After treatment with 0·83 per cent. oil emulsion, this fell from 66·2 for individuals 43–46 days old (mostly adults) to 61·6 for those 29–32 days old (of which 20 per cent. had passed the first stage) and was 95·4, 100 and 98·7 for those 13–18, 10–17 and 5–10 days old. After treatment with 0·83 per cent. oil with 0·1 per cent. wettable DDT, it rose from 90·3 for insects 43–46 days old to 100 for those 13–18 days old or younger (all of which were in the first stage). The latter treatment would thus require only one further application later in the summer. Observations in 1948–49, 15–20 days after treatment at various times of the year with sprays containing 0·1 per cent. DDT and 0·8 per cent. oil, showed that mortality increased with the degree of developmental activity of the population and the temperature, so that treatment is best applied when the Coccid is actively developing.

As it was suspected that the comparatively poor results given by parathion with oil emulsion in the preliminary experiments might have been due to the effect of the high alkalinity of the latter or the parathion, tests were carried out in 1950–51 in which one of the proprietary formulations known in France as oleoparathions was included. These contain parathion and emulsifiable oil, but have an almost neutral reaction. In 1950, sprays were applied on 7th July, and the mortality percentages on 25th–28th October, calculated as before, were 21 for 0·015 per cent. parathion in an emulsion spray, 76·4 for 0·83 per cent. oil emulsion, 89·7 for these two together, 94·8 for the oleoparathion diluted to contain 0·8 per cent. oil and 0·015 per cent. parathion, and 86·7 for 0·1 per cent. wettable DDT with 0·83 per cent. oil emulsion. In 1951, the three last treatments were applied on 6th August, and the trees were artificially infested on 11th–16th and 18th–27th August and 5th–11th September. Counts 15 days after each infestation showed that the percentage mortality among crawlers that affixed themselves decreased as the date of infestation became later. It fell from 100 and 98·7 after infestation on the first date to 61 and 36·1 after infestation on the last for the oleoparathion and parathion alone, respectively, and from 69·7 to 46·1 after infestation on the second and third dates for DDT with oil emulsion. For no treatment, it ranged from 5·8 to 14·6. Fewer crawlers became fixed after treatment with the oleoparathion than after the other treatments, particularly after infestation on the first two dates.

It is concluded that parathion in oil, particularly in the form of an oleoparathion, is superior to parathion alone, and is less susceptible to climatic and biological conditions than DDT with oil.

d'Aguilar (J.), Benard (R.) & Bessard (A.). **Une méthode de lavage pour l'extraction des arthropodes terricoles.**—*Ann. Épiphyt.* **8** no. 1 pp. 91–99, 2 figs., 6 refs. Paris, 1957.

In the method described, samples of about 500 cc. soil are broken up and soaked for 24–48 hours in 1 per cent. sodium citrate, to facilitate the dispersion of soil particles. They are then poured into a washing device. This consists of a cylinder about 8 ins. in diameter and 10 ins. high, and made of plastic, preferably transparent, except for a middle section about 2·5 ins. high, which is made of wire gauze having 300 meshes per metric inch (2·7 cm.) and is thus fine enough to retain small arthropods. There is a plug in the bottom for emptying, and the whole is supported on legs. The sample is washed against the gauze by means of a jet of water, until the water passing the gauze is clear, and is then emptied out and passed through four wire-gauze filters having 20, 60, 120 and 200 meshes per metric inch placed successively over the apparatus. Arthropods retained by the first of these can be separated by eye, but the materials retained on the others are washed into a density separator, in which the arthropods are floated to the surface by means of a solution of potassium bromide with a density of 1·35, which is heated to 50°C. [122°F.] to facilitate the collection of Collembola.

Tadić (M.). **Trešnjina osa.** [*Caliroa limacina.*]—*Plant Prot.* no. 37 (1956) pp. 7–19, 10 figs., 12 refs. Belgrade [1957]. (With a Summary in English.)

Caliroa (*Eriocampoides*) *limacina* (Retz.) is an important pest of fruit trees, chiefly pears and stone fruits, in Yugoslavia. Observations in the district of Zemun showed that the first adults appear at the end of April or the beginning of May. The egg stage lasted 7–13 days, and the larvae fed for a minimum of 17·5 days, destroying an average of about 24 per cent. of the total leaf surface, equivalent on sour cherry to 1–2 leaves per larva. Pupation occurred in the soil, mostly within 2 ins. of the surface, but sometimes as deep as 6 ins., and the pupal stage lasted 4–7 days, though as the adults did not leave the cocoons immediately, the total period spent in the soil was about 20 days. The females laid 22–82 eggs each.

Karaman (Z.). **Nekoliko zapažanja o masovnoj pojavi none** (*Lymantria monacha* **L.) u makedonskim šumama.** [Observations on an Outbreak of *L. monacha* in Forests in Macedonia.]—*Plant Prot.* no. 37 (1956) pp. 73–80, 3 refs. Belgrade [1957]. (With a Summary in German.)

An outbreak of *Lymantria monacha* (L.) occurred on beech in mountain forests in western Macedonia in 1955 in which there were few or no spruce or other coniferous trees. Where conifers were present, the damage was much less. Important control was afforded by *Calosoma sycophanta* (L.) and *Pentatoma rufipes* (L.), but insect parasites were rare. Some of the larvae and pupae were killed by a polyhedral virus disease. The latter became more widespread in 1956, when nearly 57 per cent. of the first- and

second-instar larvae were found to be infected in mid-May, and it was favoured by cool wet weather, so that infection reached 78–100 per cent. among larvae in the first three instars in mid-June.

Weiser (J.). **Die Krankheiten des Tannentriebwicklers, *Cacoecia murinana* Hb. in der Mittelslowakei (ČSR).** [The Diseases of *Choristoneura murinana* in central Slovakia.]—*Z. PflKrankh.* **63** pt. 4 pp. 193–197, 3 figs., 5 refs. Stuttgart, 1956. (With a Summary in English.)

An outbreak of *Choristoneura* (*Cacoecia*) *murinana* (Hb.) began on silver fir [*Abies alba*] in central Slovakia in 1954. Of larvae collected in the summer of 1955, 63 per cent. completed their development normally, 28 per cent. were infected with virus diseases, 2 per cent. had been attacked by unspecified insect parasites and predators, and 9 per cent. were infected by fungi (including *Beauveria bassiana* and *B. globulifera*), bacteria (*Pseudomonas*) or protozoa. The protozoa comprised two species of microsporidia that occurred in the fat-body and are described as *Nosema cacoeciae* and *N. murinanae*, spp. n. An undescribed Mermithid was isolated from one larva.

Ohnesorge (B.) & Thalenhorst (W.). **Zur Kenntnis der Fichten-Blattwespen. IV. Die Dispersion.** [Contributions to Knowledge of the Spruce Sawflies. IV. Dispersion.]—*Z. PflKrankh.* **63** pt. 4 pp. 197–211, 6 figs., 11 refs. Stuttgart, 1956. (With a Summary in English.)

In this further part of a series [*cf. R.A.E.*, A **46** 195], the authors describe investigations carried out mainly in the Harz region of Germany on the dispersion of the various stages of the sawflies that infest spruce trees. The following is based on their summary of the results. The adults preferred sunny sites sheltered from the wind, and the eggs were usually fairly evenly distributed. The immature stages of *Pristiphora abietina* (Christ) and *Pachynematus pallescens* (Htg.) occurred on trees of which the buds had been in a suitable condition at the time of oviposition, but the adults of the other species were present long enough for this factor to be of little importance for later distribution. Several species showed preferences as regards vertical distribution, but whether these were ecologically or physiologically determined was not known. The crown region of a uniform stand was in general fairly evenly infested, with a greater population density at the edges, where the area available for infestation was greater. The horizontal distribution of the cocoons in the litter corresponded fairly closely with that of the eggs and larvae on the trees. In general, sawfly distribution was continuous only in a very few cases, semi-continuous in the majority of cases and discontinuous when the population density was low or the sawflies were restricted to particular trees, as in *Pristiphora abietina* and *Pachynematus pallescens*.

Quednau (W.). **Die biologischen Kriterien zur Unterscheidung von *Trichogramma*-Arten.** [Biological Criteria for the Differentiation of Species of *Trichogramma*.]—*Z. PflKrankh.* **63** pt. 6 pp. 333–344, 3 figs., 28 refs. Stuttgart, 1956. (With a Summary in English.)

Trichogramma semblidis (Auriv.), *T. cacoeciae* Marchal and *T. embryophagum* (Htg.) are usually regarded as, at most, races of *T. evanescens*

(Westw.) [*cf. R.A.E.*, A **37** 115], but the author considers them to represent distinct species separable on the basis of physiological and morphological criteria. All occur in central Europe, *embryophagum* being typical of forests, in which it parasitises the eggs of *Panolis flammea* (Schiff.), *Acantholyda pinivora* Ensl. (*nemoralis* (Thoms.)) and *Bupalus piniarius* (L.), *evanescens* of fields under cruciferous crops, on which it attacks *Mamestra* (*Barathra*) *brassicae* (L.) and *Pieris brassicae* (L.), *semblidis* of moorland, where it parasitises *Sialis lutaria* (L.) (*flavilatera* (L.)), and *cacoeciae* of orchards, where its host is *Tortrix* (*Cacoecia*) *rosana* (L.). The last two have also been observed occasionally in fields of crucifers. *Trichogramma minutum* Ril., which occurs in the United States, is probably a field species. Investigations in Germany on the differences between these five forms are recorded.

When reared in eggs of *Anagasta* (*Ephestia*) *kühniella* (Zell.), *cacoeciae* normally gave rise to females only, the occurrence of males being quite exceptional; females of the others paired repeatedly and gave rise to offspring of which about two-thirds were females, and unpaired females of *minutum* and *semblidis* produced male offspring. These were dimorphic in the case of *semblidis*, but their morphology varies with the host species in which they develop. Superparasitism led to the production of apterous dwarf males, but only those of *semblidis* lacked typical long-haired antennae. There were constant differences in colour, and these were particularly evident after rearing at 27–30°C. [80·6–86°F.]. Females of *cacoeciae* and *embryophagum* were a shiny yellow, both sexes of *minutum* and *evanescens* grey-brown, and those of *semblidis* black-brown [*cf.* **23** 442]. Males were somewhat more pigmented than females, and pigmentation increased as the rearing temperature was decreased, as in most insects. In rearing tests in eggs of *A. kühniella* kept in the dark at 80 per cent. relative humidity, development of the five forms lasted 206, 202, 162, 162 and 176 hours, respectively, at 31°C. [87·8°F.], and 9, 8·5, 6·5, 7·5 and 7·5 days at 33°C. [91·4°F.]. At 34°C. [93·2°F.], development of *cacoeciae*, *evanescens* and *T. minutum* lasted 9·5, 7·5 and 6·5 days, and at 35°C. [95°F.] that of the last two lasted 7·5 and 7 days.

There were differences in the host range of the five forms. Newly emerged adults of *Trichogramma* and newly laid host eggs were used in tests at 27°C. and 80 per cent. relative humidity, carried out in the dark. All five forms readily parasitised *M. brassicae* and *A. kühniella*, with little mortality of the developing parasites, and all but *embryophagum* readily parasitised *Sitotroga cerealella* (Ol.), but, in general, *Acanthoscelides obtectus* (Say) (*obsoletus*, auct.), *Tenebrio molitor* L. and *Cimex lectularius* L. were unfavourable for all five, parasite mortality in eggs of these species being complete or almost so. However, *cacoeciae*, *evanescens* and *Trichogramma minutum* were the only ones to parasitise *Galleria mellonella* (L.), only *cacoeciae* and *evanescens* parasitised *Pieris brassicae*, and *semblidis* was the only one to attack *Sialis lutaria*, though *evanescens* has been recorded as attacking isolated eggs of this species, with high mortality of the offspring [**27** 36, 390]. The five forms can thus be differentiated by their reactions to these three hosts.

There were also differences in oviposition. When abundant eggs of *A. kühniella* or *G. mellonella* were provided twice a day, *T. minutum* laid three-quarters of its eggs on the first day, whereas *evanescens* oviposited at a much slower rate, though the total laid was much the same. The numbers of eggs laid and (in brackets) the length of life of the females in days at 25°C. [77°F.] averaged 78·3 (15·6) for *cacoeciae*, 42·5 (11·5) for *embryophagum*, 81·7 (7·2) for *T. minutum*, 87·2 (16) for *evanescens* and 62·6 (13·2) for *semblidis* in eggs of *A. kühniella*, and 14·2 (10·4), 2·5 (6·9),

29·1 (4·5), 57 (9·7) and 0·1 (3·1), respectively, in those of *G. mellonella*. These figures, though not permitting differentiation of the five forms, were consonant with the results of the host-range test.

Finally, reliable differences were observed in the shape of the male antennae and the marginal trichiation of the fore-wings of both sexes at 27°C. These differences, which are described and figured, permit the five forms to be separated from one another, except for the females of *cacoccicae* and *embryophagum*. The trichiation of the fore-wings varies with breeding temperature, but the forms can always be differentiated in pure cultures by a combination of their morphological and physiological characters.

Weber (G.). **Insektenfanglampen für den Warndienst.** [Insect Light-traps for Warning Purposes.]—*Z. PflKrankh.* **63** pt. 9 pp. 545–550, 4 figs., 6 refs. Stuttgart, 1956. (With a Summary in English.)

The correct timing of sprays for the control of *Cydia pomonella* (L.) on apple requires observations on adult flight in spring, and light-traps were tested for this purpose in western Germany in 1953–54. A trap designed by the author consisted of a circular white-enamelled plate about a yard in diameter, sloping slightly downwards from the centre. This was set up horizontally on a post and covered, except for the extreme edge, with a thin coating of adhesive, and the light was fixed to the centre of the upper surface. Several such traps were operated in orchards and it was found that incandescent lamps of up to 100 watts gave satisfactory results, more powerful ones causing so much stimulation of the moths that they adhered to the plate on their backs and became unrecognisable. Most were caught in the evening, just after dusk, and operation for a period of four hours proved sufficient. Various small moths of importance as orchard pests were taken, but data sufficient for the forecasting of dates for spraying against *C. pomonella* were obtained only when several traps were operated at a time in fairly large, old orchards. The trap had the disadvantage that the catch had to be examined on the spot, and a light-trap of the Minnesota type [*cf. R.A.E.*, A **46** 223, etc.], with a detachable container for the catch, was therefore compared with it. This was found to attract mainly larger species of Lepidoptera, such as Noctuids, and was inferior to the other as regards the smaller species.

Martini (C.). **Eine Herkunft des Blumenkohlmosaikvirus (Cauliflower Mosaic Virus) aus der Umgebung von Bonn.** [A Source of Cauliflower Mosaic Virus in the Neighbourhood of Bonn.]—*Z. PflKrankh.* **63** pt. 10 pp. 577–583, 3 figs., 23 refs. Stuttgart, 1956. (With a Summary in English.)

Cabbages growing near Bonn were found in September 1955 to be suffering from a virus disease, which was identified from the thermal death-point of the virus (80°C. [176°F.]), its restriction to crucifers in tests with mechanical inoculation, and its transmission by insects as the cauliflower mosaic of English and United States workers. In feeding tests with insects, flea-beetles (*Phyllotreta atra* (F.) and *P. undulata* Kutsch.) and larvae of *Phytomyza rufipes* Mg. and *Pieris brassicae* (L.) all failed to transmit [*cf. R.A.E.*, A **28** 321], but *Myzus persicae* (Sulz.), *M. ascalonicus* Doncaster, *M. circumflexus* (Buckt.), *Rhopalosiphoninus staphyleae* Koch (*Rhopalosiphum tulipaellus* Theo.) and *Aphis fabae* Scop. transmitted when batches of two apterae that had fed on a source of infection were transferred to healthy plants and allowed to feed for five minutes. A preliminary period

of fasting had little effect on the proportion of transmissions, except doubtfully in the case of *M. circumflexus*, which did not transmit when this was less than an hour.

Endrigkeit (A.). **Zur vorbeugenden Bekämpfung der Kohlschabe** (*Plutella maculipennis* **C.**) **mit HCH in Wurzeltauch-, Anzuchtbeet- und Pflanztopfbegiessungsverfahren.** [Preventive Control of *P. maculipennis* with BHC in Tests of Root Dips and Watering of Beds and Pots.]—*Z. PflKrankh.* **63** pt. 10 pp. 583–586, 9 refs. Stuttgart, 1956. (With a Summary in English.)

In the experiments described, which were carried out against *Plutella maculipennis* (Curt.) in north-western Germany in the summer of 1951, γ BHC treatments were applied to young cabbage or cauliflower and the results estimated about six weeks later by counting the feeding holes left by the larvae on treated and untreated plants. For cabbage, the reductions amounted to 75 per cent. when the roots were dipped in a suspension of 0·02 per cent. γ BHC in soil and water and 87 per cent. when plants in pots (200 cc. capacity) were watered with 80 cc. of an emulsified solution of 0·2 per cent. γ BHC in such a manner that the plant parts above the soil were not wetted. For cauliflower, they were 73 per cent. when the beds were watered with 0·3 per cent. γ BHC and 54–61 per cent. when the roots were dipped in 0·05–0·1 per cent. γ BHC. Since the district was exposed to strong winds, the results are provisionally attributed to a systemic effect of the BHC.

Hůrka (K.). **Experimentaluntersuchungen zur Überschwemmung der Waldmaikäferengerlinge** (*Melolontha hippocastani* **F.**). [Experimental Investigations on the Flooding of Larvae of *M. hippocastani*.]—*Beitr. Ent.* **6** no. 1–2 pp. 13–17, 10 refs. Berlin, 1956.

It is concluded from the laboratory experiments described that the death of larvae of *Melolontha hippocastani* F. submerged in water is due to the entry of water into the body and not to lack of oxygen. Mortality increased with time of exposure and temperature, but was less in flooded soil than in flooded sand or in water alone. At 20°C. [68°F.], a high proportion of third-instar larvae survived flooding in soil for ten days.

Fröhlich (G.). **Zur Frage der biologischen Abhängigkeit der Kohlschoten-Gallmücke** (*Dasyneura brassicae* **Winn.**) **vom Kohlschotenrüssler** (*Ceuthorrhynchus assimilis* **Payk.**). [The Problem of the biological Dependence of *D. brassicae* on *C. assimilis*.]—*Beitr. Ent.* **6** no. 1–2 pp. 100–110, 7 figs., 26 refs. Berlin, 1956.

Oviposition by *Dasyneura brassicae* (Winn.) in the pods of rape is held by many to be dependent on the presence of holes made by *Ceutorhynchus assimilis* (Payk.). The author reviews the literature on this subject [*cf. R.A.E.*, A **45** 206, etc.] and records observations made near Leipzig, Germany. These showed that infestation by *C. assimilis* bore no direct quantitative relation to that by *D. brassicae* and that larvae of the two insects rarely occurred in the same pod. Females of *D. brassicae* were observed boring into pods not exceeding 4 cm. in length, but, in cage tests with second-generation adults, little infestation by the Cecidomyiid occurred unless the weevil was also present.

Dosse (G.). **Über die Entwicklung einiger Raubmilben bei verschiedenen Nahrungstieren (Acar., Phytoseiidae).** [On the Development of some predacious Mites on various Prey Species.]—*Pflanzenschutzberichte* **16** pt. 7–9 pp. 122–136, 8 refs. Vienna, 1956. (With a Summary in English.)

Predacious mites afford important control of phytophagous mites on fruit trees near Stuttgart, Germany, and investigations were carried out to determine whether they could survive and reproduce on these alone and which species were preferred. Field-collected females and mating pairs were transferred to small cells in the laboratory, and black paper was used as the substrate instead of leaves, so that only animal food would be available. The results obtained with *Typhlodromus cucumeris* Oudm. have already been noticed [*R.A.E.*, A **46** 203], and those obtained with *T. tiliae* Oudm., *T. soleiger* (Ribaga), *T. aberrans* Oudm. (*vitis* Oudm.), *T. tiliarum* Oudm. and *Phytoseius macropilis* (Banks) (*spoofi* (Oudm.)) are here presented, together with notes on their distribution.

Of these species, *T. tiliae* was the most numerous. When examples of *Tetranychus telarius* (L.) (*urticae* Koch) (mainly in the resting and nymphal stages) were provided in abundance, development was completed in averages of 7·2 days at 25–26°C. [77–78·8°F.] and 23·4 days at 15–16°C. [59–60·8°F.] and a relative humidity of 85 per cent. At 30°C. [86°F.], development was completed in 7 days, but many of the eggs died and adults developed from less than half of those laid. At 25–26 and 15–16°C., the number of eggs laid daily averaged 1·3 and 0·4 per female, the maximum total numbers per female were 58 and 25, and the oviposition period lasted for up to six and more than eight weeks, respectively. When only eggs of *T. telarius* were provided, development was completed in an average of 9·9 days. Other prey species readily available on untreated trees were *Panonychus* (*Metatetranychus*) *ulmi* (Koch), *Czenspinskia lordi* Nesbitt and often also *Tydeus* (*Brachytydeus*) sp. When all stages of *P. ulmi* were provided as food, development lasted an average of 8·4 days and the highest number of eggs laid per female was 33. Neither adults nor nymphs were observed to feed on the eggs of *P. ulmi* [*cf.* **45** 336], and this finding was confirmed in the field. When all stages of *C. lordi* were provided, very large numbers were required to keep the predator mites alive; one female needed to feed intensively for 14 days before laying two eggs, and the few nymphs that received sufficient food to complete their development did so in an average of 17·4 days at 25–26°C. It is concluded that this mite would be attacked only when others are not available. *Typhlodromus tiliae* could not be induced to feed on *Tydeus*. Four generations were reared during the vegetative period of 1955. In the field, pairing was observed on dried leaves before or after they had fallen, until the beginning of November, when the males die and and the females enter hibernation [*cf.* **45** 336]. Females collected in October and kept at a temperature of 25–26°C. after pairing oviposited after 2–3 weeks, and normal reproduction continued throughout the winter.

Typhlodromus soleiger was found on plum and apple frequently on trees infested by *Eotetranychus pomi* Sepasgosarian [**46** 291] and Tydeids. When it was reared on *Tetranychus telarius*, development was completed in 11·1 days at 25–26°C., and similar results were obtained with *P. ulmi*, but neither adults nor nymphs could be induced to feed on *C. lordi* and no eggs were laid in any of these tests. When it was reared on *Tydeus* sp. and *Lorryia* sp., together with a few individuals of *Triophtydeus*, which was scarce, development was completed in an average of 7·5 days at 25–26°C., at which the average daily number and the total number of eggs laid were 1·4

and 50 per female, respectively, and in six days at 30°C., at which the number of eggs laid daily averaged 2 per female, but most were devoured by the ovipositing females themselves; it lasted 28·4 days at 15–16°C., at which mortality during development was high and the average daily and total numbers of eggs laid were 0·6 and 22 per female, respectively. At 10–11°C. [50–51·8°F.], the adults were able to survive, but not more than two eggs were laid per female and mortality during development was complete. Females reared on *Tydeus* and paired with males reared on *Tetranychus telarius* laid eggs, whereas those reared on *T. telarius* and paired with males reared on *Tydeus* did not. In a further test, ten females of *Typhlodromus soleiger* reared on *Tydeus* sp. and *Lorryia* sp. at 25–26°C. were paired with males reared under similar conditions. As soon as eggs were laid, the males were removed and five of the females were fed on *Tetranychus telarius* and five on *P. ulmi*. Oviposition ceased and the mites became emaciated, but they recovered and resumed oviposition at the normal rate when *Tydeus* was supplied 8–10 days later.

Typhlodromus aberrans and *T. tiliarum* were also found on apple and plum but were less numerous. *T. aberrans* was commonest on trees infested by *Bryobia praetiosa* Koch and spinning mites (chiefly *E. pomi*). When it was reared on *Tetranychus telarius*, development lasted an average of 8·1 days and the average daily and total numbers of eggs laid were 1·1 and 16 per female, respectively, at 25–26°C.; only one individual completed its development at 15–16°C., in 29 days. *Typhlodromus tiliarum* was also reared on *Tetranychus telarius*; the average daily and total numbers of eggs laid were 1 and 19 per female, respectively, at 25–26°C., and total development lasted an average of 8·8 days at that temperature and 23·5 days at 15–16°C.

Phytoseius macropilis was also found to be quite common on apple and plum, but had not previously been recorded from Germany. When it was reared on *T. telarius*, the average daily and total numbers of eggs laid and the development period in days were 0·8, 18 and 7·7 at 25–26°C., and 0·3, 17 and 32·2 at 15–16°C. It was able to subsist on the eggs of this species alone, but continuous feeding on *T. telarius* was unfavourable, the mites becoming sickly and dying. Development on *Panonychus ulmi* was completed in 7·1 days and on *C. lordi* in 8·4 days at 25–26°C. The latter mite appears to be the preferred food. When fed on *Tydeus*, the nymphs died before reaching the second instar and adult females did not oviposit.

Both sexes of all the mites passed through a larval and two nymphal stages. The larvae did not feed, and although the nymphs and adults preferred the resting stages of their prey, they devoured active mites of all ages voraciously, and it is concluded that these predators are able to survive and reproduce entirely on animal food.

Picco (D.). **Attività di alcuni prodotti contro le uova ibernanti di** *Paratetranychus pilosus* **anche in rapporto al sistema di allevamento dei fruttiferi.** [The Activity of certain Products against the overwintering Eggs of *Panonychus ulmi* in Relation to the System of raising Fruit Trees.]—*Notiz. Mal. Piante* no. 42 (N. S. no. 21) pp. 65–71. Pavia, 1957. (With a Summary in English.)

Large numbers of winter eggs of *Panonychus ulmi* (Koch) (*Paratetranychus pilosus* (C. & F.)) were observed on apple and pear near Piacenza early in 1957, and sprays were tested for their control. Those applied to both fruits comprised a product containing tar distillate in oil, diluted to 6 per cent. in water, one containing 36 per cent. of the triethanolamine salt of dinitro-sec.-butylphenol, diluted to 1 per cent., and one

containing 2·7 per cent. DNC, 73 per cent. oil and 24 per cent. emulsifiers, diluted to 4 per cent., all applied on 1st March, a preparation containing 45 per cent. oil, 20 per cent. parathion and 35 per cent. adjuvants, diluted to 0·3 per cent., applied on 23rd March, when the flower buds were partly open, and lime-sulphur, which was known to have no effect on winter eggs and was applied in mid-March as a control. The results were estimated on 26th April by taking samples of ten leaves from each of five trees per row of 50, and indices of infestation calculated by multiplying the average number of mites per leaf by the probit corresponding to the percentage of leaves infested. On apple, the indices averaged 9·73, 33·3 and 1·52 for the three products applied on 1st March, 36·069 for the parathion spray, and 122·03 for lime-sulphur, and on pear they averaged 12·595, 120·317, 11·22, 95·597 and 142·37, respectively. Pear was also sprayed on 1st March with a product containing 69 per cent. tar distillate and dinitrobutylphenol and 31 per cent. emulsifiers, diluted to 5 per cent., and the indices for this averaged 21·515. The differences required for statistical significance at 5 and (in brackets) 1 per cent. were about 53·4 (75·35) on apple and 61·3 (83·2) on pear. The pear trees were of the cordon shape, which had been thought likely to facilitate control, but this proved not to be the case, possibly owing to easier dispersion of the mite on such trees.

Breny (R.). **L'embryon de** *Neodiprion sertifer* **Geoffr. en période hivernale.** —*Bull. Inst. agron. Gembloux* **24** no. 2 pp. 121–130, 2 figs., 1 graph, 5 refs. Brussels, 1956. **Contribution à l'étude de la diapause chez** *Neodiprion sertifer* **Geoffr. dans la nature.**—*Mém. Acad. R. Belg., Cl. Sci.* Coll. in 8°. **30** fasc. 3, 86 [+2] pp., 8 figs., 2 graphs, 68 refs. Brussels, 1957.

In the first of these papers, the author shows that the development of the eggs of *Neodiprion sertifer* (Geoffr.) in pine needles in Belgium is interrupted during the winter. The interruption lasted from mid-December to the end of January in 1954–55.

In the second, he gives a detailed account of field and laboratory observations on the cause of this interruption and shows that it is not a true diapause, but a state of dormancy induced by lack of available moisture in the needles. Eggs removed from the needles and transferred to suitable conditions of temperature and moisture developed continuously and hatched within six weeks of being laid.

Papers noticed by Title only.

Tachikawa (T.). **The Japanese Species of the Genus** *Coccophagus* **and their Hosts (Hymenoptera: Aphelinidae).** [*In Japanese & English.*] —*Jap. J. appl. Ent. Zool.* **1** no. 1 pp. 61–64. Tokyo, 1957.

Watanabe (C.). **Insects of Micronesia. Vol. 19 no. 2. Hymenoptera: Eucharidae.**—pp. [5+] 19–34, 8 figs., 1 map. Townes (H.). **Hymenoptera: Ichneumonidae, Stephanidae, and Evaniidae.**—pp. 35–87, 14 figs. Honolulu, Bishop Mus., 1958. [*Cf. R.A.E.*, A **43** 345; **46** 156.]

Chamberlin (F. S.). **History and Status of the Green Peach Aphid** [*Myzus persicae* (Sulz.)] **as a Pest of Tobacco in the United States.**—*Tech. Bull. U.S. Dep. Agric.* no. 1175, [1+] 12 pp., 35 refs. Washington, D.C., 1958. [A review of the literature.]

FAO Plant Protection Bulletin

A Publication of the

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The Bulletin is issued monthly in English, French, and Spanish, twelve numbers constituting a volume. Subscription rates are $3.00 or 15s. per annum; single numbers are priced at $0.30 or 1s. 6d. The citation is FAO Plant Protection Bulletin, or, in abbreviation, FAO Plant Prot. Bull.

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Printed in Great Britain under the authority of HER MAJESTY'S STATIONERY OFFICE
by The Eastern Press, Ltd., London and Reading

(2780) Wt. P8508/3923 10/58 E.P. Ltd. Gp. 566. [A]